$25.00 U.S

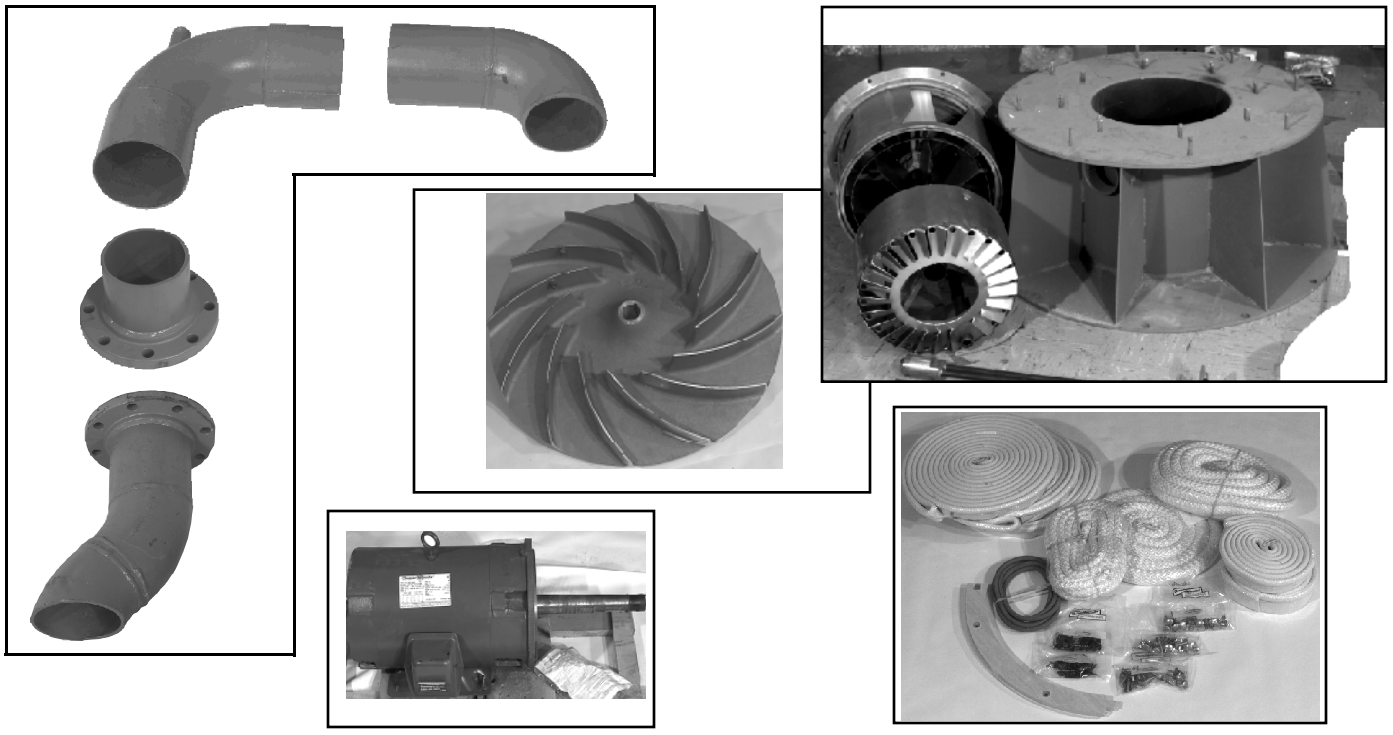
CLEAVER-BROOKS

IFGR Retro-Fit

250 - 800hp.

Installation Instructions

Induced Flue Gas Recirculation



Manual Part No. 750-181

2/98

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SAFETY PRECAUTIONS AND ABBREVIATIONS

Safety Precautions

It is essential to read and understand the following safety precautions before attempting to operate the equipment. Failure to follow these precautions may result in damage to equipment, serious personal injury, or death. A complete understanding of this manual and the respective boiler Operation and Maintenance manual is required before attempting to start-up, operate or maintain the equipment. The equipment should be operated only by personnel who have a working knowledge and understanding of the equipment. When setting up or operating the burner, be sure to reference the applicable flame safeguard control manual.

The following symbols are used throughout this manual:

⚠ WARNING

This symbol indicates a potentially hazardous situation which, if not avoided, could result in serious personal injury, or death.

⚠ CAUTION

This symbol indicates a potentially hazardous situation which, if not avoided, could result in damage to the equipment.

NOTICE

This symbol indicates information that is vital to the operation of this equipment.

Abbreviations

Following is an explanation of the abbreviations, acronyms, and symbols used in this manual.

AC	Alternating Current
AR	Automatic Reset
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
BHP	Boiler Horsepower
BTU	British Thermal Unit
°C	Degrees Celsius
CFH	Cubic Feet per Hour
Cu Ft	Cubic Feet
DC	Direct Current
°F	Degrees Fahrenheit
FM	Factory Mutual
FS	Flame Safeguard
ft	Feet
GPM	Gallons per Minute
Hd	Head
HT	Height
HTB	High Turndown Burner
HZ	Hertz
In H_2O	Inches of Water
IRI	Industrial Risk Insurance
Lb	Pound
LE	Low Emission
LWCO	Low-Water Cut-Off
MM	Million
MFD	Micro-Farad
MR	Manual Reset
NEC	National Electric Code
No.	Number
pH	Measure of the degree of acid or base of a solution
P/N	Part Number
PPM	Parts Per Million
PR	Program Relay
psi	Pounds Per Square Inch
SAE	Society of Automotive Engineers
scfh	Standard Cubic Feet per Hour
T	Temperature
TC	Temperature Control
TI	Temperature Gauge
UL	Underwriter's Laboratories
V	Volt
WC	Water Column
WSI	Watts Per Square Inch

CLEAVER-BROOKS

IFGR Retro-Fit

250 - 800 hp Installation Instructions

Induced Flue Gas Recirculation

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Please direct purchase orders for replacement manuals to your local Cleaver-Brooks authorized representative.

Manual Part No. 750-181

2/98

Printed in U.S.A.

⚠WARNING

DO NOT OPERATE, SERVICE, OR REPAIR THIS EQUIPMENT UNLESS YOU FULLY UNDERSTAND ALL APPLICABLE SECTIONS OF THE APPROPRIATE OPERATION AND MAINTENANCE MANUAL.

DO NOT ALLOW OTHERS TO OPERATE, SERVICE, OR REPAIR THIS EQUIPMENT UNLESS THEY FULLY UNDERSTAND ALL APPLICABLE SECTIONS OF the appropriate Operation and Maintenance MANUAL.

FAILURE TO FOLLOW ALL APPLICABLE WARNINGS AND INSTRUCTIONS MAY RESULT IN SEVERE PERONAL INJURY OR DEATH.

TO: Owners, Operators and/or Maintenance Personnel

This installation manual presents information that will help to properly setup and care for the equipment. Study its contents carefully. The unit will provide good service and continued operation if proper operating and maintenance instructions are followed. No attempt should be made to operate the unit until the principles of operation and all of the components are thoroughly understood. Failure to follow all applicable instructions and warnings may result in severe personal injury or death.

It is the responsibility of the owner to train and advise not only his or her personnel, but the contractors' personnel who are servicing, repairing or operating the equipment, in all safety aspects.

Cleaver-Brooks equipment is designed and engineered to give long life and excellent service on the job. The electrical and mechanical devices supplied as part of the unit were chosen because of their known ability to perform; however, proper operating techniques and maintenance procedures must be followed at all times. Although these components afford a high degree of protection and safety, operation of equipment is not to be considered free from all dangers and hazards inherent in handling and firing of fuel.

Any "automatic" features included in the design do not relieve the attendant of any responsibility. Such features merely free him of certain repetitive chores and give him more time to devote to the proper upkeep of equipment.

Because of state, local, or other applicable codes, there are a variety of electric controls and safety devices which vary considerably from one boiler to another.

Operating controls will normally function for long periods of time and we have found that some operators become lax in their daily or monthly testing, assuming that normal operation will continue indefinitely. Malfunctions of controls lead to uneconomical operation and damage and, in most cases, these conditions can be traced directly to carelessness and deficiencies in testing and maintenance.

The operation of this equipment by the owner and his operating personnel must comply with all requirements or regulations of his insurance company and/or other authority having jurisdiction. In the event of any conflict or inconsistency between such requirements and the warnings or instructions contained herein, please contact Cleaver-Brooks before proceeding.

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Installation Instructions
IFGR RETROFIT

General Information

This manual identifies the installation of the **I**nduced **F**lue **G**as **R**ecirculation (**IFGR**) systems for retrofit applications. These systems are used on 78" Model CB firetube dryback boilers (250 - 350hp). They are designed to provide a NOx performance of under 30 ppm (3% O_2, dry basis) when firing natural gas.

The equipment is designed to be installed in the field on existing boilers. In addition to the items and procedures listed, good judgment should be used to identify and address any conditions that may prevent the unit from working properly or meeting the application requirements. All operating parameters such as combustion air requirements, fuel properties, altitude compensation, operating controls should be reviewed for their related application and performance requirements.

For customer convenience, it is recommended that the installation of the IFGR retrofit kit be scheduled to coincide with annual maintenance. Be prepared with the appropriate service tools, replacement gaskets and maintenance items to perform any and all service and maintenance required.

⚠WARNING

IFGR Retro fit is only to be installed when Cleaver-Brooks manufactured inner doors and rear heads are used. Any rebuilt or modified inner door or rear head installed by a third party should be replaced or rebuilt by an authorized Cleaver Brooks Representative. The inner door and rear head must have either rigid insulation or blanket insulation firmly held in place with wire mesh, retainers and rigidizer. Loose insulation could cause blockage of the burner air flow. Failure to follow these instructions could cause serious personal injury or death.

Figure 1: 78" CB Boiler with IFGR Retrofit

BOILER PREPARATIONS:

Note: the boiler should be in good condition, with no major modifications to the original design. Components that are worn or in poor condition should be replaced or repaired.

- This conversion is designed for burners firing natural gas, light oil (ASTM #1 or #2 oil) or a combination burner firing light oil or gas. Application of other gaseous fuels must be approved by Cleaver-Brooks.

  Note: This conversion must not be capable of burning heavy oils.

- A gas fired burner must be equipped with spuds. If the existing housing will be modified to add spuds, it must be in good mechanical condition with no corrosion or cracking.
- If spuds are being added to the gas burner, the required gas pressure will probably increase. The gas pressure regulator should be capable of providing the increased pressure, or steps should be taken to obtain higher spring rates or a different regulator. Also, the gas pressure switches may require a higher setting or a different switch range.
- Oil fired units must use the High Turndown oil gun (standard equipment for light oil from about 1989).

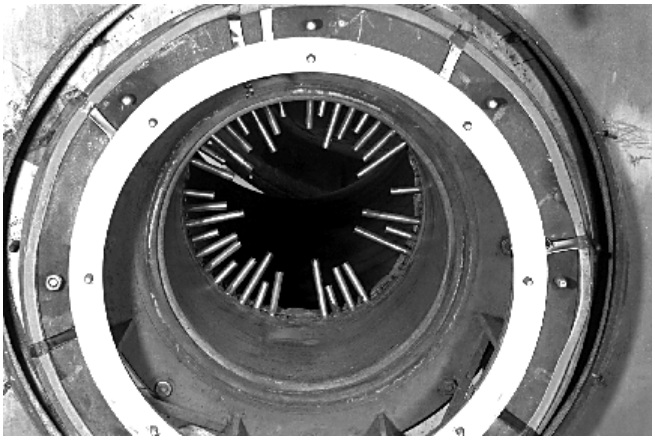


Figure 2: Spudded Burner Housing

Figure 3: High Turndown Oil Gun.

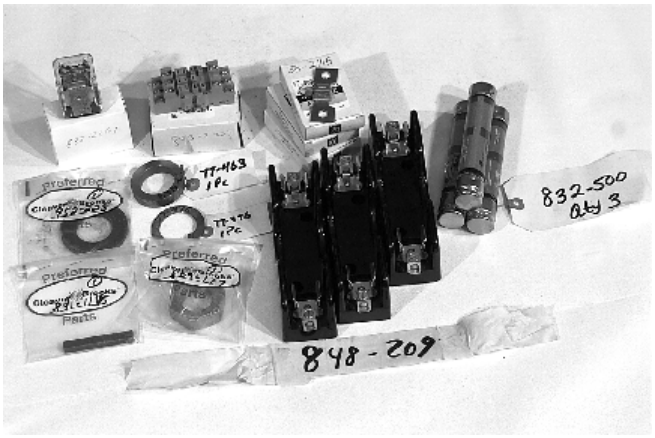


Figure 4: Additional Electrical Components May Be Required

SITE PREPARATION:

- The stack draft (pressure) must be between -0.25” and +.25” (measured in inches of water column). The draft must also be consistent, providing the same amount of draft at any given firing rate, repeatable within 0.1" (measured at the stack temperature coupling).
- Larger combustion air motors are required to provide the IFGR and maintain the rated boiler capacity. The larger motor provided in this kit may also require changes to the fuses, motor starter and interconnecting wiring. The service connection should also be reviewed to insure sufficient current supply. A new impeller, sized for the total flow requirements, is also provided.
- There should be sufficient space in front of the boiler to perform the work and to allow the larger motor to fit without obstruction of the aisle.

  Note: Before scheduling a retrofit job, be sure all the required parts and correct components have been supplied and are in good condition.
- The stack must have a minimum unobstructed straight vertical length of approximately 30" above the boiler flange to attach the IFGR piping. The stack must also be of sufficient gauge material to provide a welded connection. Stacks with multiple walls and/or thin gauge material may need to have a section replaced, using a single wall heavy gauge steel material (see installation drawings).

⚠ CAUTION

Chains or other devices used to attach a lifting device to the fan/motor must be arranged so the fan motor does not rotate or tilt when removed from the front head. Failure to follow these instructions could result in damage to the equipment.

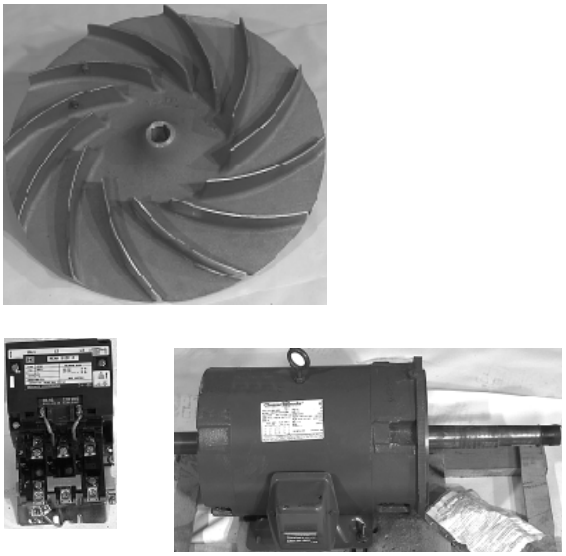


Figure 5: Impeller, Motor and Starter

Figure 6: Flue Gas Duct Piping

Figure 7: Aspirator Piping

Figure 8: Combustion Air Intake Hood

Figure 9: Insulation, insulation Retainers and Gasket Kit.

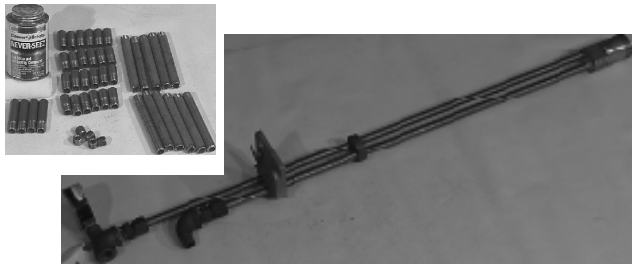


Figure 10: Spud Kit and High Turndown Oil Gun for Combination Firing

Components Supplied.

- New combustion air fan (impeller) and mounting hardware (see Figure 5).
- New combustion air motor, and motor starter (see Figure 5).
- IFGR piping for flue gas duct assembly (see Figure 6).
- Aspirate line components (see Figure 7).
- Modified air inlet assembly, to accept the IFGR duct (see Figure 8).
- Front head insulation and mounting components (see Figure 9).

  A.Front door insulation, glue, wire mesh and retaining clips.

  B.Gaskets for the front door.
- Gas burner spuds for fuel series 200 and 700 (see Figure 10).
- Oil burner nozzle for fuel series 100 and 200 (see Figure 10).

Other Items included in the IFGR Kit

- Diffuser.
- Nameplate
- Wiring Diagram.
- Operating and Maintenance Manual.

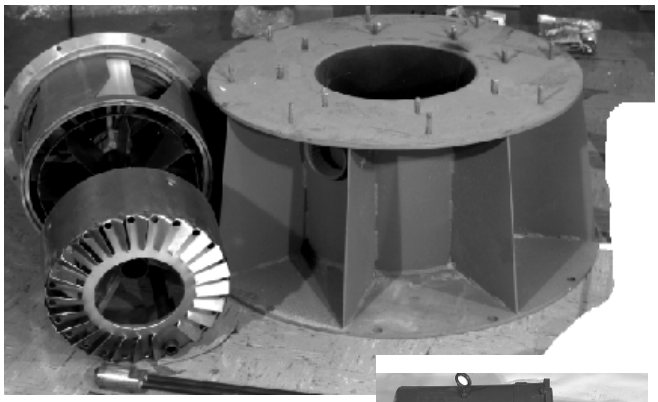


Figure 11: Optional Items; Burner Housing, High Turndown Burner and Diffuser and Fan Motor

Options

- Replacement gas burner housing.
- High turndown burner.
- The normal variations in motor options (high efficiency, TEFC, etc.) are available.

Major Installation Field Tasks.

⚠WARNING

Disconnect and lock out the main power to the boiler and the fuel supply to the burner before the front head is opened. Electrical power and fuel supply must remain shut off at all times when the front head is open. Failure to follow this warning could result in serious personal Injury or death.

⚠WARNING

Be certain that the davit arm is under tension before opening. Failure to follow these instructions can result in serious personal injury or death.

1. Remove the old fan and motor (see Figure 5). The motors can weigh several hundred pounds, and may require special rigging.
2. If the unit has oil firing, the air compressor will need to be installed on the new motor as it was with the original motor. In some cases, the tubing or piping may need to be altered to compensate for a different motor length.
3. The next step is to insulate the front door. The insulation covers the lower portion of the door, as shown in Figures 14 and 15.

   a). Check the front door for unused openings. These must be closed off to prevent flue gas from escaping into the boiler room.

   b).Retainer strips are used to hold the edge of the insulation in place at the fan outlet, due to the high air velocities. Mark the strip locations on the door for proper fit-up (item 5 & 6 on Figure 14). The retainers strips will be welded in place after the insulation and wire mesh have been installed.

   c).Weld the retainer pins to the door, maintaining 4" to 6" spacing. The retainer pins should be placed wherever the insulation will be.

   d).Cut the insulation to fit the required spaces, and glue it in place.

   e).Cut away the insulation for the air proving switch, rear door cooling line and any other required opening.

   f).Cover the insulation with the wire mesh, and cut to fit the required spaces. The mesh should have a minimum of 6" of overlap.

   g).Install the pin clips on the pins, and bend the pins flat against the wire mesh.

   h).Weld the retainer strips in place as shown on Figures 14 and 15. The insulation and wire mesh must be held firmly by the retainers

⚠WARNING

The insulation must be firmly attached to the door using high temperature glue, wire mesh, retainer studs and clips, to insure that the high air velocities will not allow the insulation to come loose and plug the burner air flow. Failure to properly attach the insulation can result in serious personal injury or death

4. Install the new fan and motor assembly. The fan and motor will be larger than the existing fan and motor to accommodate the IFGR flow. If the boiler is oil fired, install the air compressor to the base and pipe and wire accordingly. Refer to the Firetube Manual 750-91 for installation information. The motors can weigh several hundred pounds, and may require special rigging. Adjust the gap between the impeller and the housing for clearance of 0.045” to 0.060”. Check this clearance at several locations.
5. Remove the existing air inlet assembly (item 1, Figure 13) and install the new air inlet assembly provided with the kit. If this is an oil fired boiler, there will be an oil cooling coil that must be installed in the new air inlet.
6. Install the IFGR piping (item 2, Figure 13). Cut a hole in the stack at the position shown, and install and weld the components as shown in Figure 13. The piping is designed to provide a fair amount of flexibility for positioning both vertically and horizontally by use of the slip collars in the piping assemblies.
7. Install the aspirator line as shown in Figures 12 and 13. Cut a hole in the top of the front door and weld the coupling as shown.

Burner Setup

The burner setup and adjustments are described in the boiler Operation and Maintenance Manual 750-91

The NOx level should be adjusted to approximately 25 ppm throughout the firing range. There are two adjustments that can be used to obtain the desired NOx levels. First, at high fire, the IFGR rate can be reduced (to increase the NOx level) by installing an orifice plate between the flange in the IFGR piping. The orifice plate has a smaller opening than the IFGR piping assembly therefore reducing the IFGR flow. After the required NOx levels are obtained at high fire, the low fire NOx levels can be adjusted with the manually operated valve on the aspirator line. Opening the valve will increase the IFGR flow and decrease the NOx level.

Notes

BILL OF MATERIAL (SEE NOTE 5)			
ITEM	REQ'D	PART NO.	DESCRIPTION
1	1	530-C-472	AIR INLET ASS'Y, MODIFIED FOR INDUCED FGR
2	1	507-C-7527	PIPING ASSEMBLIES, INDUCED FGR (3 SECTIONS)
3	1	880-A-617	HARDWARE KIT-INDUCED FGR PIPING W/ ORIFICE PLATES
4	1	880-A-615	PIPING KIT- ASPIRATION PIPING W/ GATE VALVE
5	1	858-56	COUPLING, FULL, 2" FORGED STEEL
6	1	465-C-1680	INSULATION, FRONT HEAD INTERIOR, 78" DIA.

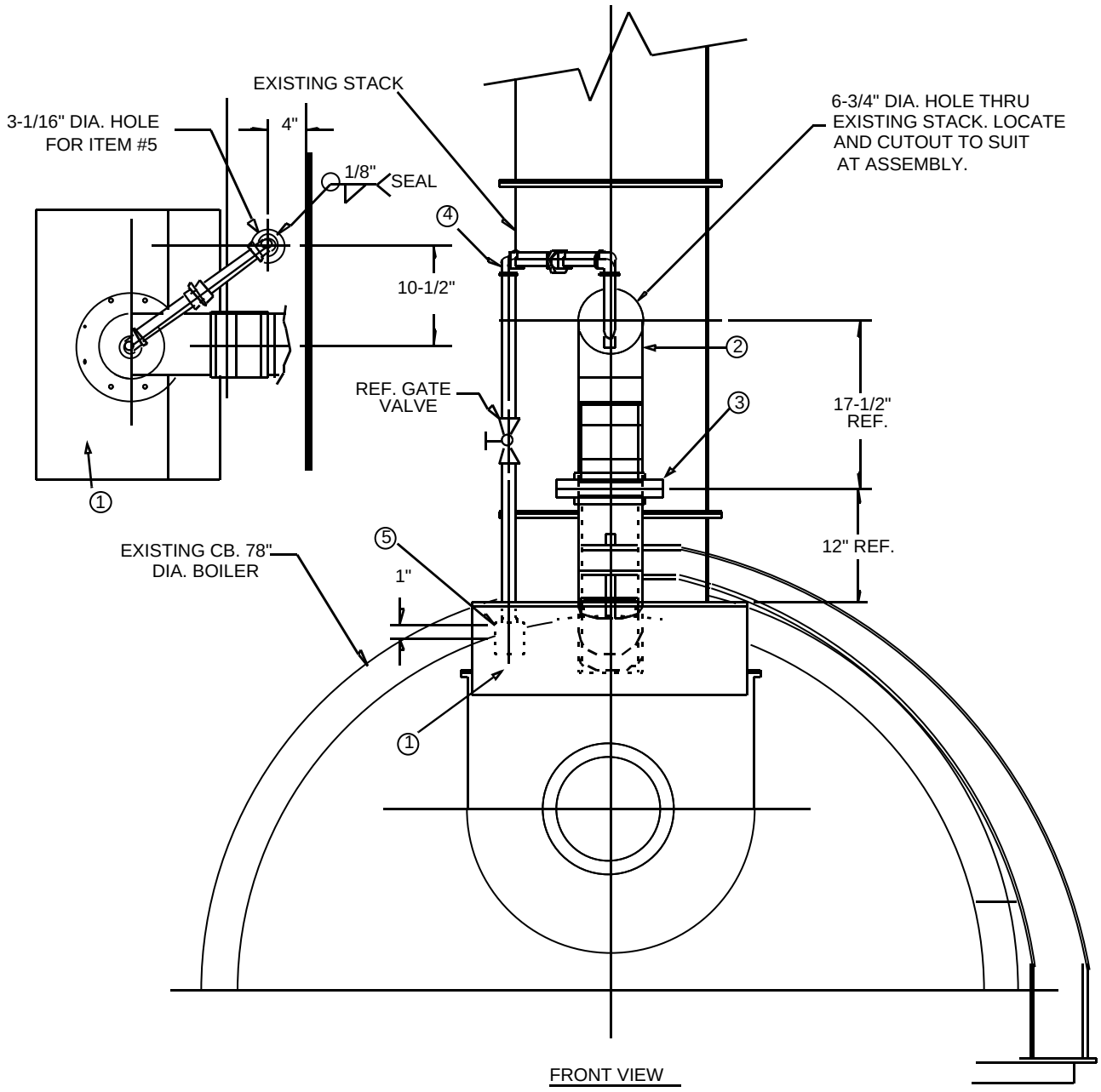


Figure 12: Retrofit-Induced FGR-78” Dia.

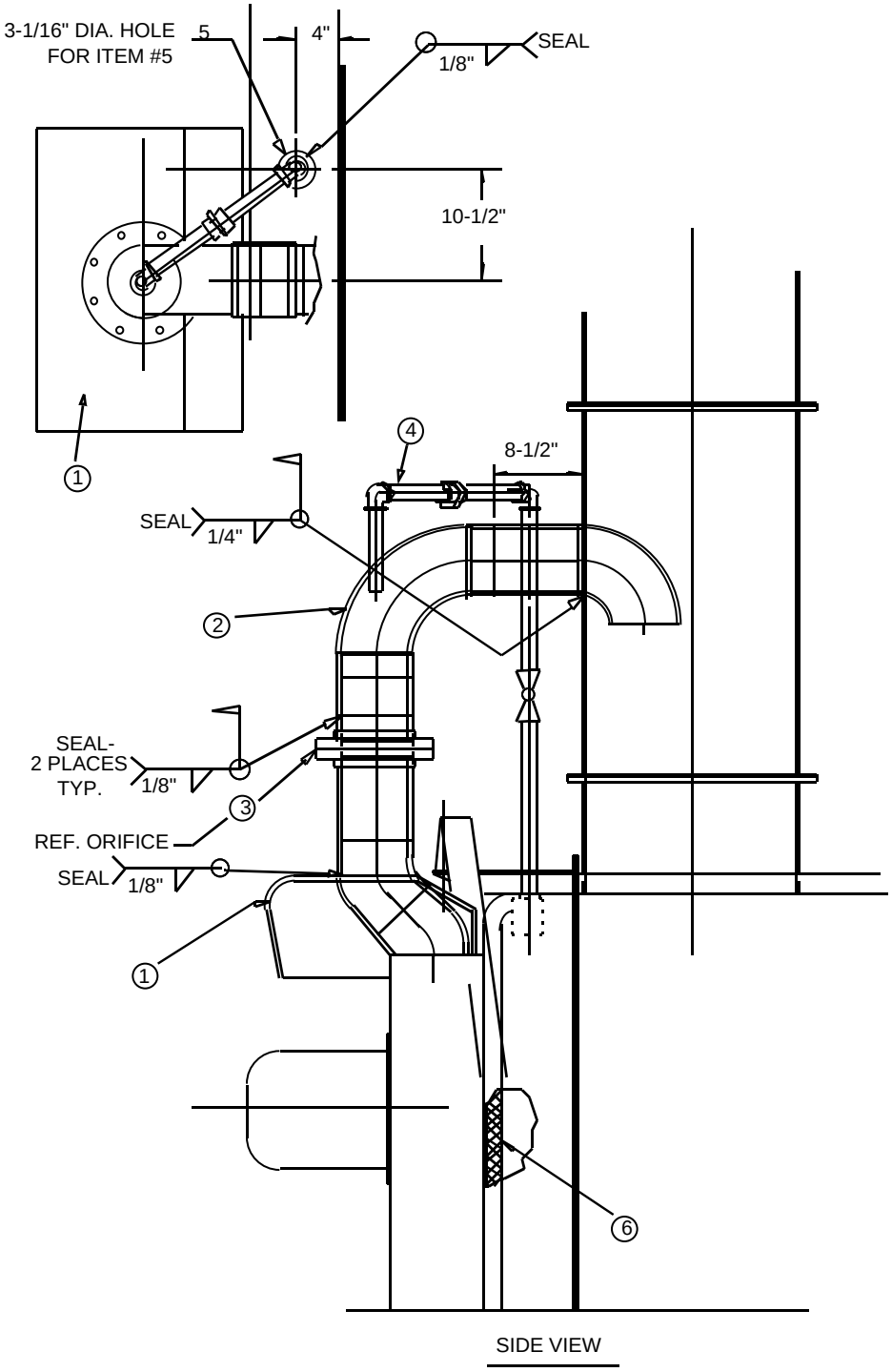
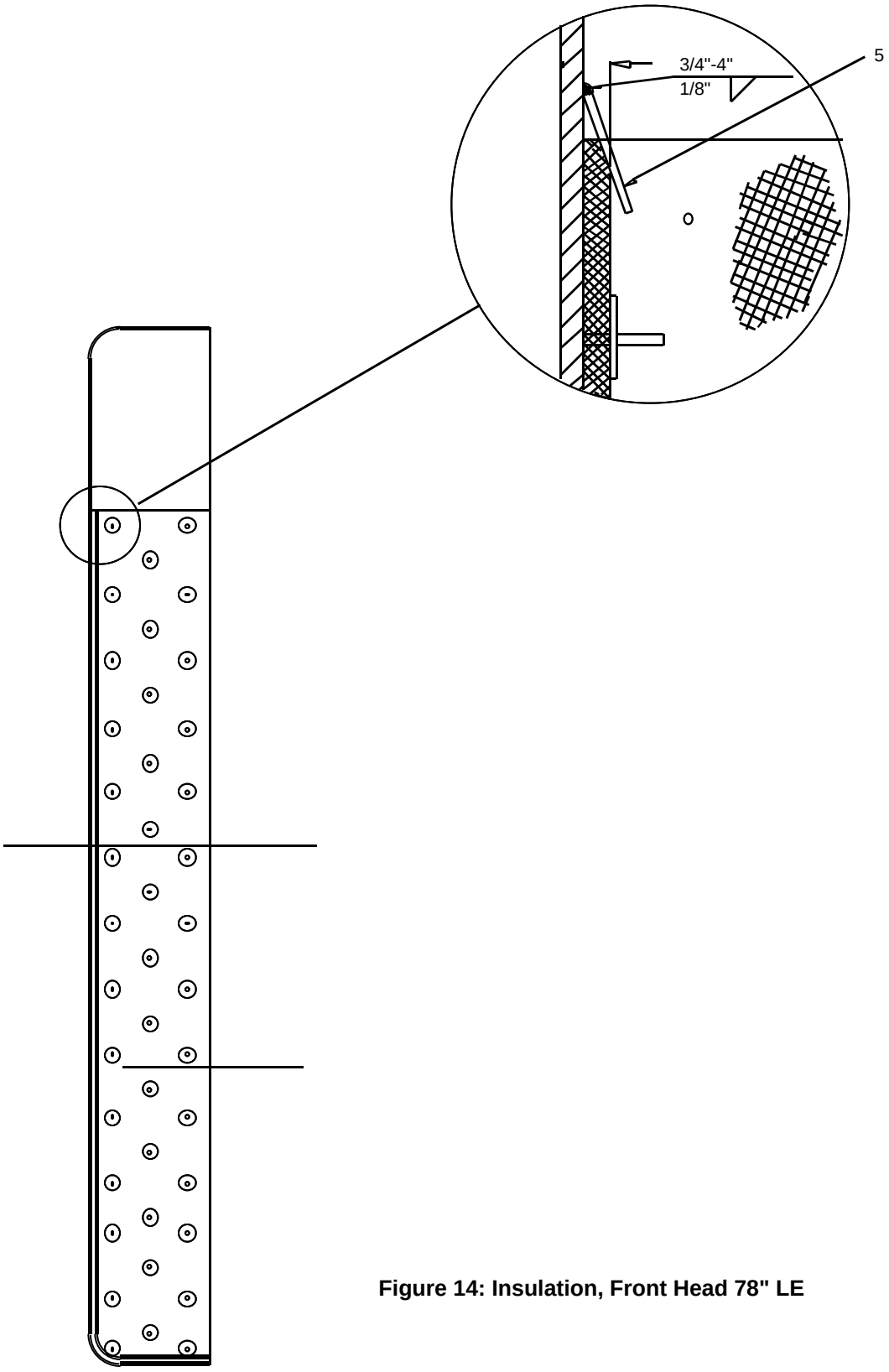


Figure 13: Retrofit-Induced FGR-78” Dia.



SECTION VIEW OF FIGURE 15

Figure 14: Insulation, Front Head 78" LE

	30 PPM 465-1680	78" GENERAL BILL OF MATERIAL	
ITEM	REQ.	PART NO.	DESCRIPTION
1	57 SQ FT	872-688	BULK INSULATION, INSULWOOL, 1/4" THK,
2	150	903-297	PIN, WELDING, #10 GA. X 2-1/2" LG. ST. STL.
3	150	828-39	CLIP, WELDING ST. STL
4	128 OZ	872-512	ADHESIVE, SCOTCHGRIP #42NF
5	2	971-355	STRIP, 14 GA. x 1-1/2" x 32-1/2" LG.
6	2	971-355	STRIP, 14 GA. x 1-1/2" x 9-1/2" LG.
7	57 SQ FT	930-57	SCREEN 1/2" 19 GA. GALV.

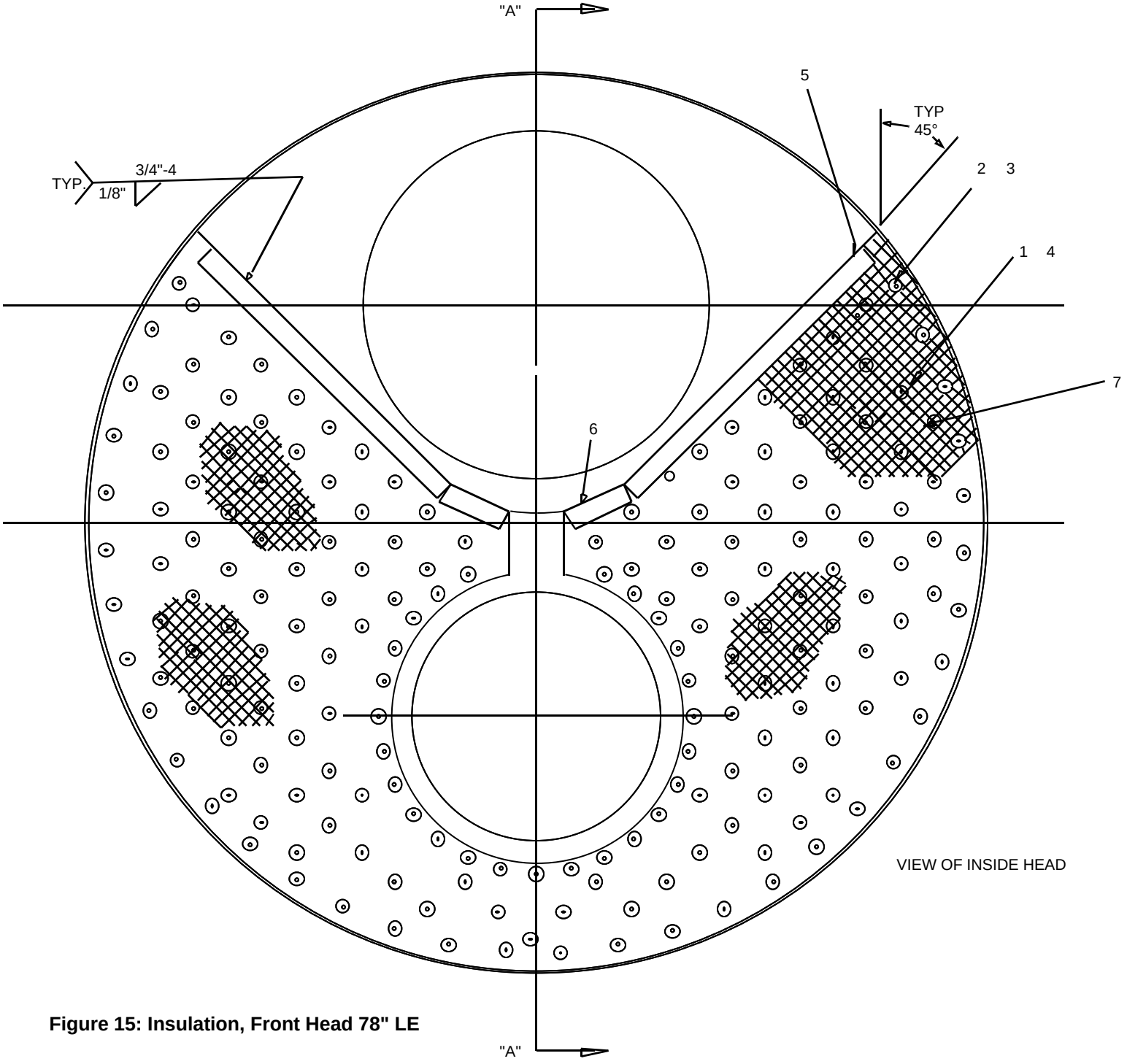
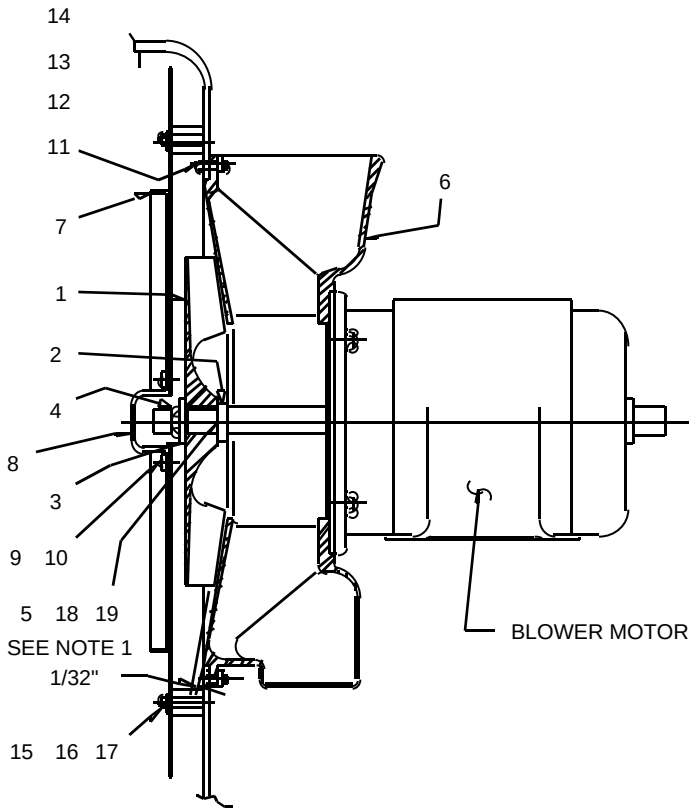


Figure 15: Insulation, Front Head 78" LE

(SEE FIGURE 14)



ITEM	QTY	PART NO.	DESCRIPTION	TABLE ITEMS 2 3 4 & 5 50-60 HZ. CB 250	CB 300 GAS	CB 300 OIL/COMB.	CB 350
1	1		IMPELLER				
2	1		SPACER, IMPELLER	77-A-101	77-A-101	77-A-102	77-A-102
3	1		WASHER	952-289	952-289	952-225	952-225
4	1		NUT, SELF LOCKING, JAM	869-119	869-119	869-177	869-177
5	-		WASHER, SPACER	91-60	91-60	91-79	91-79
6	1	85-D-263	SUPPORT, MOTOR				
7	1	22-B-237	PLATE, DIFFUSER				
8	1	19-A-375	COVER, SHAFT				
9	2	860-201	SCREW, MACH., RD. HD. #10-24 X 3/8" LG.				
10	2	952-117	LOCKWASHER, #10				
11	1	32-A-919	GASKET, AIR HOOD				
12	8	868-175	CAPSCREW, HEX. HD. 12"-12 X 1-3/4" LG.				
13	10	952-94	LOCKWASHER, 1/2"				
14	9	869-15	NUT, HEX. 1/2"-13				
15	8	77-A-103	SPACER				
16	15	952-93	LOCKWASHER, 3/8"				
17	11	869-30	NUT, HEX. 3/8"-16				
18	-		WASHER, SPACER .005	91-59	91-59	91-78	91-78
19	-		WASHER, SPACER 1/16"	91-61	91-61	91-80	91-80

TABLE ITEMS 18 & 19 — 50-60 HZ.

NOTE: 1. USE ITEMS 5 , 18 , & 19 AS REQUIRED TO OBTAIN CLEARANCE OF 1/32".

Figure 16: Impeller 78”

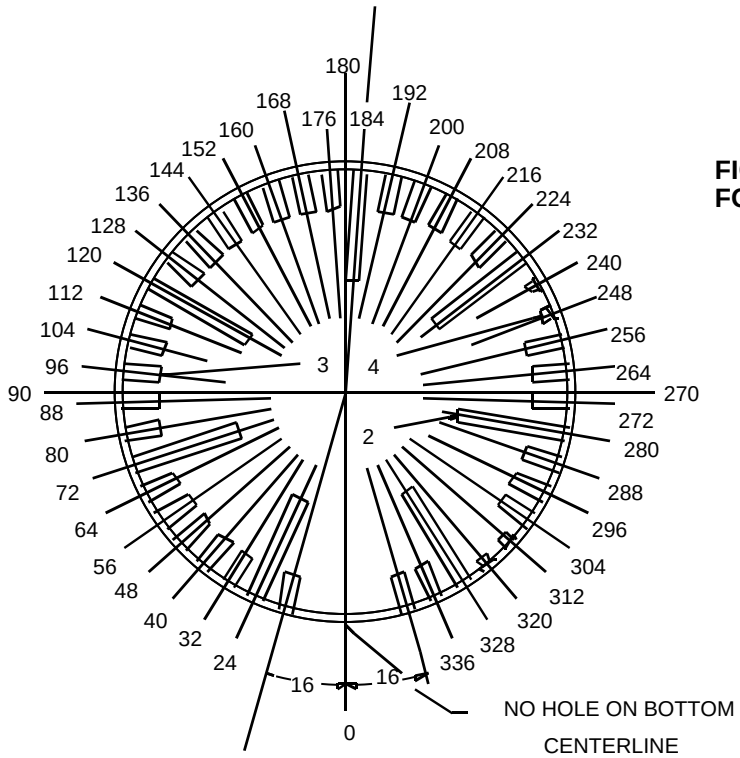


FIGURE 17: SPUD ARRANGEMENT FOR 300 AND 350 HP

NOTES!

1. SPUD PATTERN SHOWN IS AS VIEWED FROM FRONT OF BOILER, THROUGH THE HOUSING.

2. APPLY NEVER SEEZ COMPOUND, ITEM 1 , TO SPUDS AND PLUGS BEFORE INSTALLING.

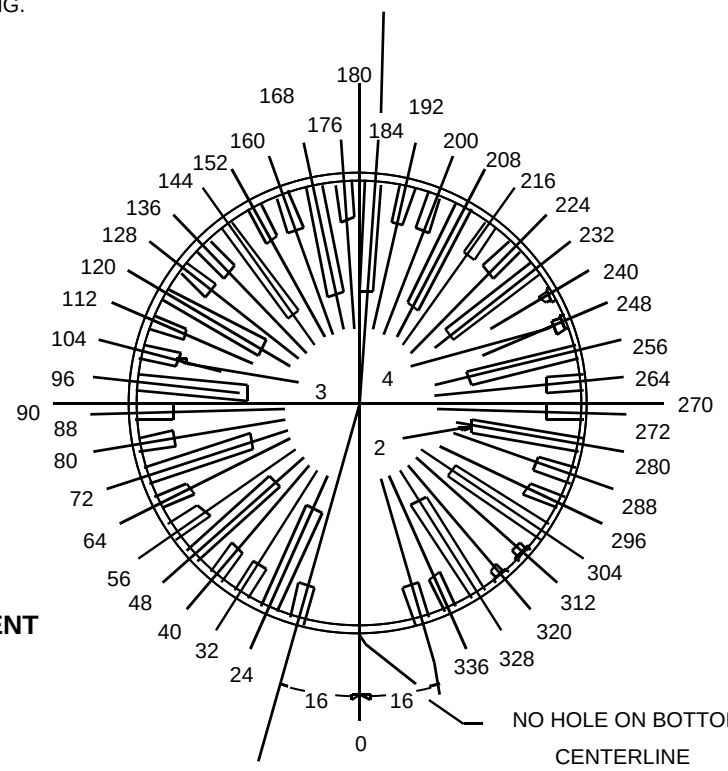


FIGURE 18: SPUD ARRANGEMENT FOR 250 HP

INSTALLATION INSTRUCTIONS

IFGR Retrofit

GENERAL INFORMATION:

This manual identifies the installation instructions for the **I**nduced **F**lue **G**as **R**ecirculation (**IFGR**) systems used on retrofit applications. These systems are used on Model CB firetube dryback boilers (400-800 hp) produced after approximately 1970. They are designed to provide a NOx performance of under 30 ppm (3% O_2, dry basis) when firing natural gas.

The equipment is designed to be installed in the field on existing boilers. In addition to the items and procedures listed, good judgment should be used to identify and address any conditions that may prevent the unit from working properly or meeting the application requirements. All operating parameters such as combustion air and stack draft requirements, fuel properties, altitude compensation, operating controls should be reviewed for their related application and performance requirements.

For customer convenience, it is recommended that the installation of the IFGR retrofit kit be scheduled to coincide with annual maintenance. Be prepared with the appropriate service tools, replacement gaskets and maintenance items to perform all service and maintenance required during the IFGR installation.

The installation of this equipment and boiler startup must be performed by a qualified service person who has a complete understanding of the installation procedures contained in this manual, access to calibrated emission test equipment, an understanding of the boiler to be retrofitted, and the appropriate Operation Service and Parts manual.

⚠WARNING

IFGR Retro fit is only to be installed when Cleaver-Brooks manufactured inner doors and rear heads are used. Any rebuilt or modified inner door or rear head installed by a third party should be replaced or rebuilt by an authorized Cleaver Brooks Representative. The inner door and rear head must have either rigid insulation or blanket insulation firmly held in place with wire mesh, retainers and rigidizer. Loose insulation could cause blockage of the burner air flow. Failure to follow these instructions could cause serious personal injury or death.

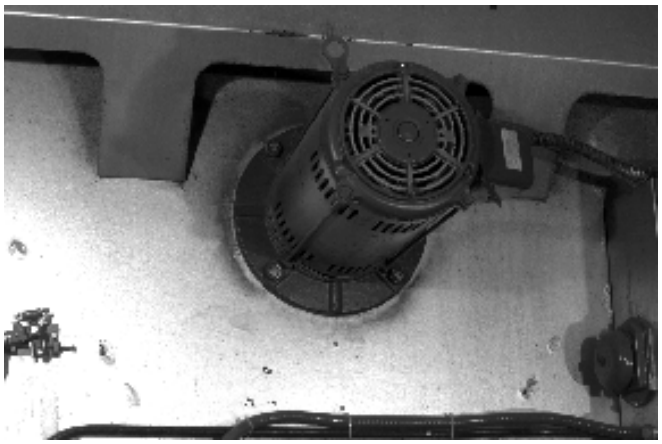


Figure 1: Impeller Motor Mounted on the Front Head with Internal Impeller.

BOILER PREPARATIONS:

Note: The boiler should be in good condition, with no major modifications to the original design. Components that are worn or in poor condition should be replaced or repaired.

- The IFGR conversion is designed for burners firing natural gas, light oil (ASTM #1 or #2 oil) or a combination burner firing light oil or gas. Application of other gaseous fuels must be approved by Cleaver-Brooks. The IFGR conversion should not be made to a burner that will burn heavy oils.

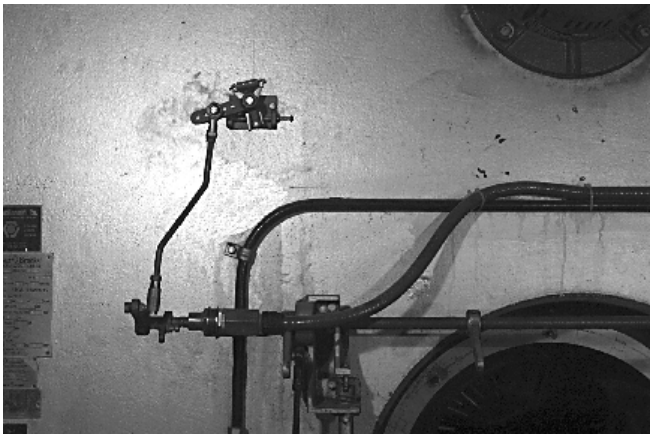


Figure 2: IFGR Linkage Requires Manual Change-Over for Dual Fuel Units and a 3/4” Jackshaft.

Figure 3: Linkage and Proximity Switch for Manual Change-Over Linkage

- A gas fired burner must be equipped with spuds. If the existing housing will be modified to add spuds, it must be in good mechanical condition with no corrosion or cracking.
- If spuds are being added to the gas burner, the required gas pressure will probably increase. The gas pressure regulator should be capable of providing the increased pressure, or steps should be taken to obtain higher spring rates or a different regulator. Also, the gas pressure switches may require a higher setting or a different switch range.
- Oil fired units must use the High Turndown oil gun (standard equipment for light oil from about 1989).

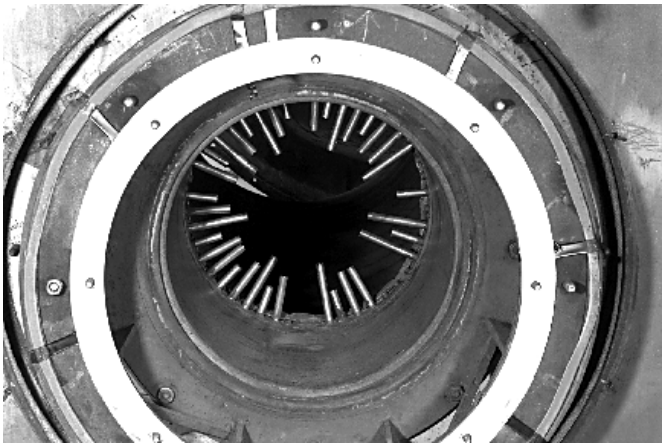


Figure 4: Spudded Burner Housing

- The burner must have a 3/4” jack shaft. A conversion is available if required.

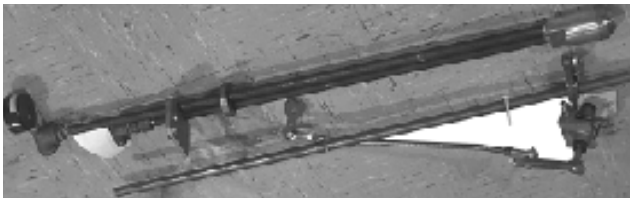


Figure 5: High Turndown Oil Gun and 3/4” Jackshaft

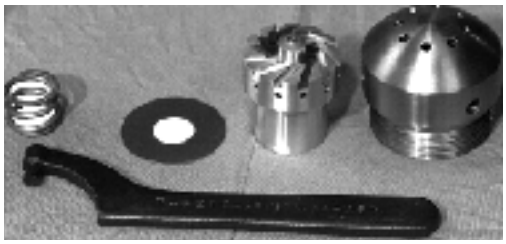


Figure 6: High Turndown Nozzle Parts.

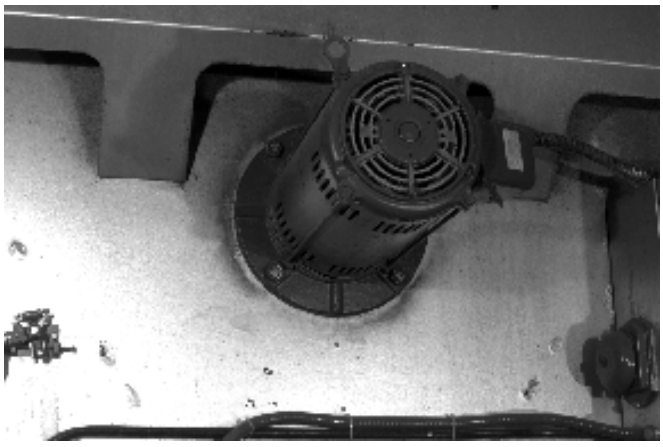


Figure 7: Larger Motors May Be Required

SITE PREPARATIONS:

- The stack draft at the boiler outlet must be between -0.25” and +0.25” water column. The draft must also be consistent, providing the same draft at any given firing rate, repeatable within 0.1" water column.
- Larger combustion air motors are required to provide for both IFGR and combustion air delivery in order to maintain the rated boiler capacity. The larger motor provided in the IFGR kit may also require changes to the fuses, motor starter and interconnecting wiring. The service connection should also be reviewed to insure sufficient current supply. A new impeller, sized for the total flow requirements, is also provided.
- There should be sufficient space in front of the boiler to perform the work and to allow the larger motor to fit without obstruction of the aisle.

Note: Before scheduling a retrofit job, be sure all the required parts and correct components have been supplied and are in good condition.

Figure 8: Additional Electrical Components May be Required

⚠ CAUTION

Chains or other devices used to attach a lifting device to the fan/motor must be arranged so the fan motor does not rotate or tilt when removed from the front head. Failure to follow these instructions could result in damage to the equipment.

COMPONENTS SUPPLIED:

- New combustion air fan (impeller) and mounting hardware.
- New combustion air motor and mounting hardware (if required).
- IFGR duct and related hardware.
- Linkage to connect the jackshaft to the IFGR duct.
- 3/4” jackshaft with extended length for the IFGR linkage connection.
- Components to rework the front baffle.
- Gas burner spuds (for fuel series 200 and 700) if not on the existing burner.
- Combustion air motor starter.
- Front head insulation, glue, wire mesh and retaining clips.
- Gaskets for the front head.
- Nameplate.
- Wiring Diagram.
- Installation instructions.

OPTIONS

- Boiler derating, where larger motors may not be required, and some burner components are changed to allow the boiler to operate at a lower capacity.
- The IFGR conversion may be combined with the High Turndown Burner conversion, which will add the capability for increased turndown of both the gas and oil firing capabilities of the boiler.
- Several other conversion options (Flame Safeguard, adding a fuel, updating fuel trains to meet current insurance regulations, etc.) could be included with the IFGR conversion, reducing overall cost of installation and down tome.

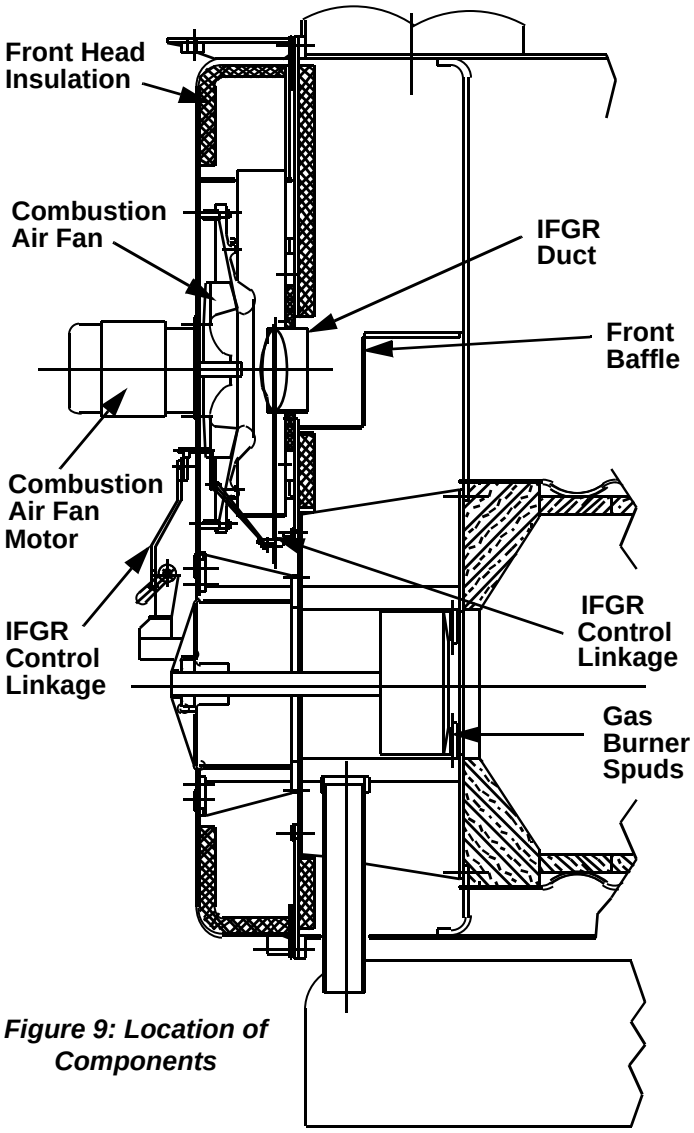


Figure 9: Location of Components

Figure 10: Motor Starter, Insulation, Insulation Retainers, and Gasket Kit.

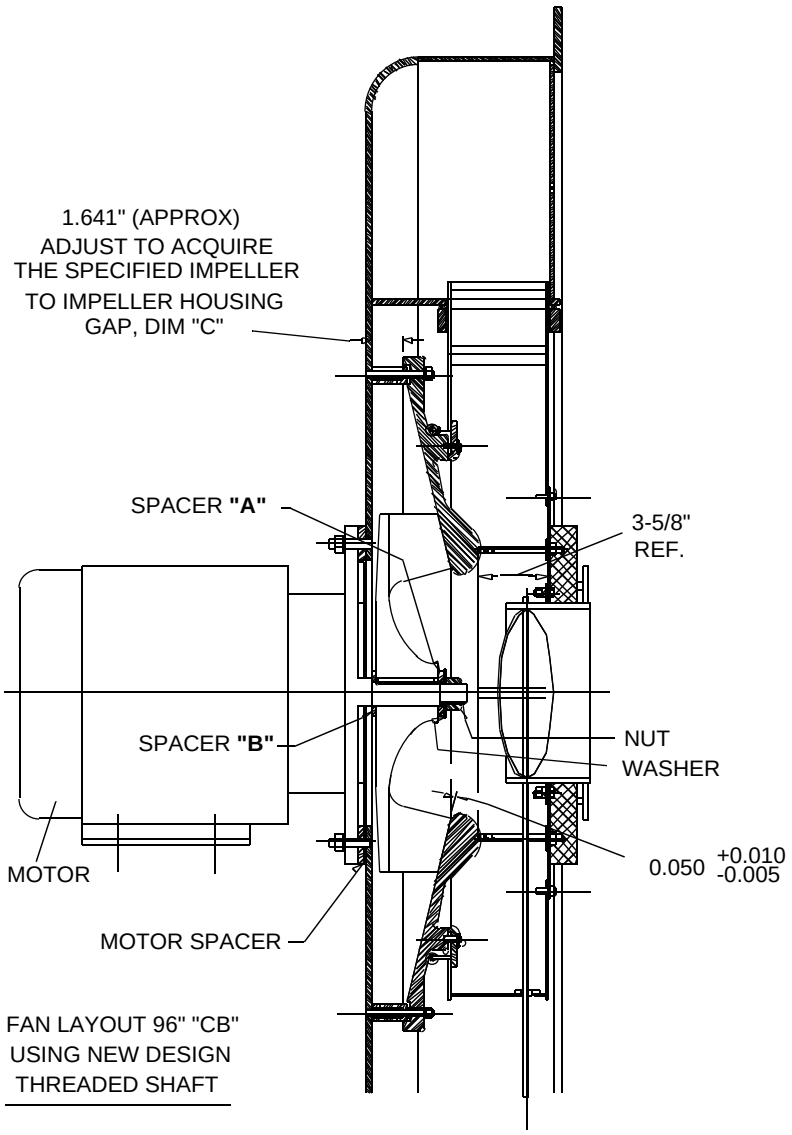


Figure 11: Impeller Assembly

Table 1: Impeller Retainer Part Numbers and Size Requirements.

MOTOR HP	SHAFT SIZE	IMPELLER SPACER **"A"**	IMPELLER SPACER **"B"**	NUT	WASHER	MOTOR SPACER
10	1-3/8"	77-478 (1/4")	77-478 (1/4")	869-177	952-225	NOT REQ.
15 ODP	1-3/8"	77-478 (1/4")	77-478 (1/4")	869-177	952-225	NOT REQ.
15 TEFC	1-3/8"	77-432 (3/8")	77-436 (1/8")	869-177	952-225	77-465
20	1-3/8"	77-432 (3/8")	77-436 (1/8")	869-177	952-225	77-465
25	1-3/8"	77-463 (7/16")	77-476 (1/16")	869-177	952-225	77-465
30	1-3/8"	77-463 (7/16")	77-476 (1/16")	869-177	952-225	77-465
40 ODP	1-5/8"	77-462 (7/16")	77-477 (1/16")	869-180	952-338	77-465
40 TEFC	1-5/8"	77-462 (7/16")	77-477 (1/16")	869-180	952-338	77-466
50	1-5/8"	77-446 (5/8")	77-477 (1/16")	869-180	952-338	77-466
60	1-5/8"	77-462 (7/16")	77-477 (1/16")	869-180	952-338	77-466
75	1-5/8"	77-462 (7/16")	77-477 (1/16")	869-180	952-338	77-466

MAJOR FIELD INSTALLATION TASKS.

The following outline covers the installation of major IFGR components. This work must be performed by qualified individuals who are trained in the installation and setup of low emission Cleaver-Brooks burners. In addition, other skills are required to perform welding, wiring and other tasks. It is the installers responsibility to insure that properly trained individuals are performing the work.

⚠WARNING

Disconnect and lock out the main power to the boiler and the fuel supply to the burner before the front head is opened. Electrical power and fuel supply must remain shut off at all times when the front head is open. Failure to follow this warning could result in serious personal Injury or death.

⚠WARNING

The inner door must be in good operational and mechanical condition. If excessive cracking or deterioration is evident, replacement of the rear door is required to prevent plugging of burner air flow. Failure to follow this warning could result in serious personal injury or death.

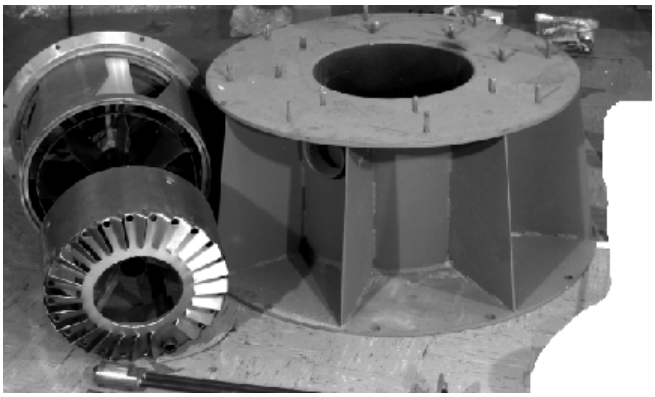


Figure 12: Optional Items; Burner Housing, High Turndown Burner and Diffuser.

⚠WARNING

Be certain that the davit arm is under tension before opening. Failure to follow these instructions can result in serious personal injury or death.

1. Remove the old fan and motor, and install the new fan and motor. Refer to the Firetube Manual 750-94 for information on fan and motor removal. The motors can weigh several hundred pounds, and may require special rigging.
   - Some specific motor size increases will require a modification to the front door opening and motor mounting stud location. Specifically, this will happen when the motor changes from a 286TD (or smaller frame) to a 324TD or larger frame. The details for this change are shown on Figure 13.

   Note: The 286TD motor frame will be 40 hp or smaller in an Open Drip Proof design, or 30 hp or smaller in a TEFC design for current motor production. Older motor styles and other motor requirements will have different frame and hp relationships.

   - See Figure 11 and Table 1 for the assembly details showing the spacers, fan and nut assembly to the motor shaft.
   - The fan housing should be positioned to provide a gap of 0.045” to 0.06” between the housing and the impeller. The clearance should be checked at several locations around the diameter and at the inside and outside of the impeller diameter.
   - If the new motor is 30 hp or larger, it will require a motor support. The motor support must be bolted to the motor base and adjusted for proper alignment prior to welding the support to the front head.
2. Drill the three holes in the front head for mounting the IFGR linkage over travel mechanism (see Figures 2 and 13). Cut 6” from the end of the brace on the inside of the front head, as shown on Figure 13 to provide space for the IFGR linkage.

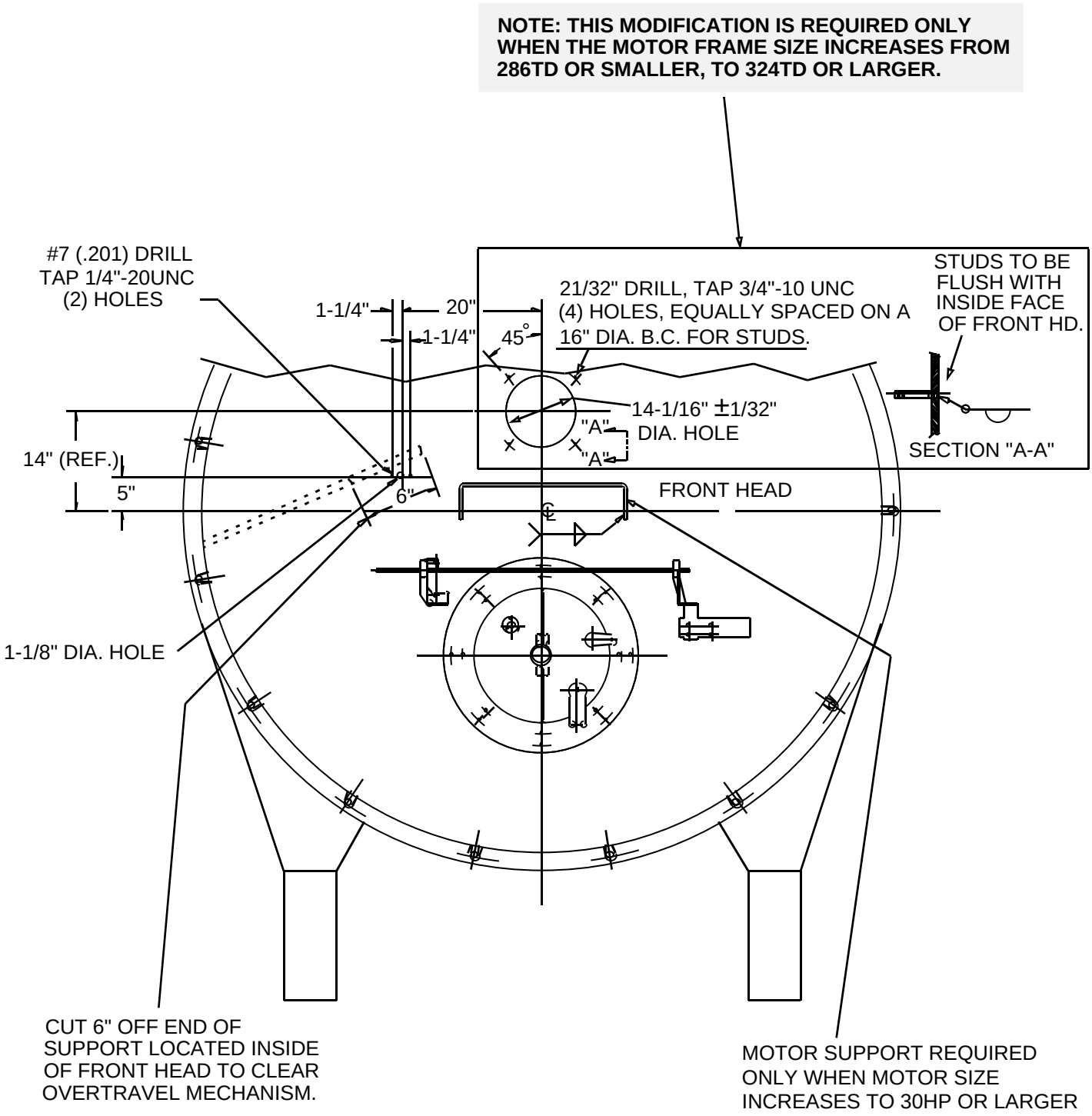

NOTE: THIS MODIFICATION IS REQUIRED ONLY WHEN THE MOTOR FRAME SIZE INCREASES FROM 286TD OR SMALLER, TO 324TD OR LARGER.
#7 (.201) DRILL TAP 1/4"-20UNC (2) HOLES
1-1/4"
20"
1-1/4"
45°
21/32" DRILL, TAP 3/4"-10 UNC (4) HOLES, EQUALLY SPACED ON A 16" DIA. B.C. FOR STUDS.
STUDS TO BE FLUSH WITH INSIDE FACE OF FRONT HD.
14-1/16" ±1/32" DIA. HOLE
"A"
"A"
SECTION "A-A"
14" (REF.)
5"
6"
FRONT HEAD
1-1/8" DIA. HOLE
CUT 6" OFF END OF SUPPORT LOCATED INSIDE OF FRONT HEAD TO CLEAR OVERTRAVEL MECHANISM.
MOTOR SUPPORT REQUIRED ONLY WHEN MOTOR SIZE INCREASES TO 30HP OR LARGER

Figure 13: Required Modifications to the Front Head When Using a Motor With a Larger Frame Size

3. The next step is to insulate the front head. The insulation covers the lower portion of the head, as shown in Figures 14 and 15.

⚠WARNING

The insulation must be completely and firmly attached to the door, so that the high air velocities will not allow it to come loose. Failure to properly attach the insulation can result in serious personal injury or death

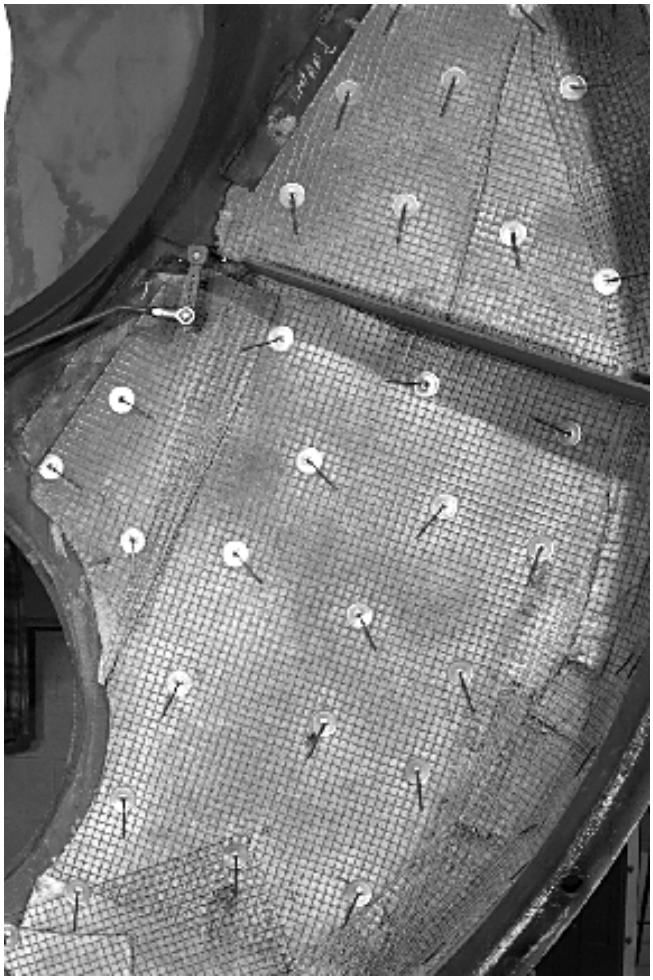


Figure 14: Insulation and Wire Mesh Installed Inside Front Head.

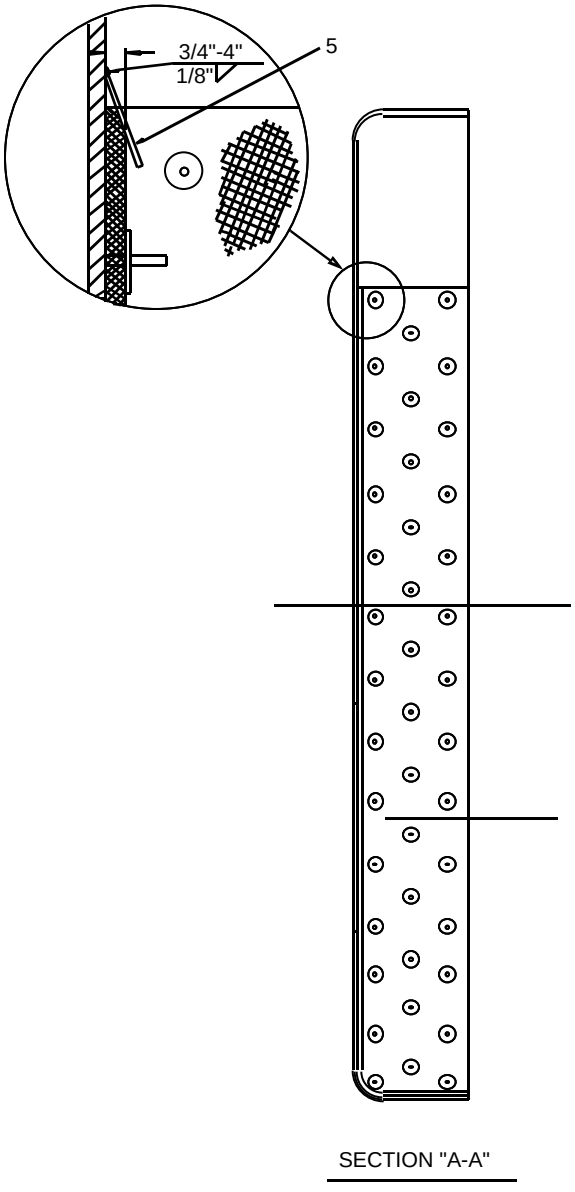


Table 2: Front Head Insulation and Retainer Hardware.

	96" GENERAL BILL OF MATERIAL	
ITEM	PART NO.	DESCRIPTION
1	872-688	BULK INSULATION, INSULWOOL, 1/4" THK.
2	903-297	PIN, WELDING, #10 GA. X 2-1/2" LG. ST. STL.
3	828-39	CLIP, WELDING ST. STL.
4	872-512	ADHESIVE, 3M #42NF
5	971-355	STRIP, 14 GA. x 1-1/2" x 33" LG.
6	971-355	STRIP, 14 GA. x 1-1/2" x 9-1/2" LG.
7	N/A	N/A
8	N/A	N/A
9	930-57	SCREEN 1/2" 19 GA. GALV

- Check the front door for unused openings. These must be closed to prevent recirculated flue gases from escaping into the boiler room.
- Retainer strips are used to hold the edge of the insulation in place at the fan outlet, due to the high air velocities at the fan outlet. Mark the strip locations on the door for proper fit-up of the insulation and wire mesh. The retainer strips will be welded into position after the insulation and wire mesh has been installed.
- Weld the retainer pins to the inside of the front head, maintaining 4” to 6” spacing. The retainer pins should be placed wherever the insulation will be secured to the front head.
- Cut the insulation to fit the required places and glue it in place.
- Cut away the insulation around the air proving switch, rear door sight glass cooling line, the IFGR linkage, and any other required opening.
- Cover the insulation with the wire mesh and cut the wire mesh to fit the required spaces. A minimum overlap of 6” should be used whenever two sections of wire mesh are joined.
- Install the pin clips on the pins to hold the wire mesh and insulation tight against the door. Bend the pins flat against the wire mesh (see Figure 14).
- Weld the retainer strips in place as shown on Figures 14 and 15. The insulation and wire mesh must be held firmly by the retainers.

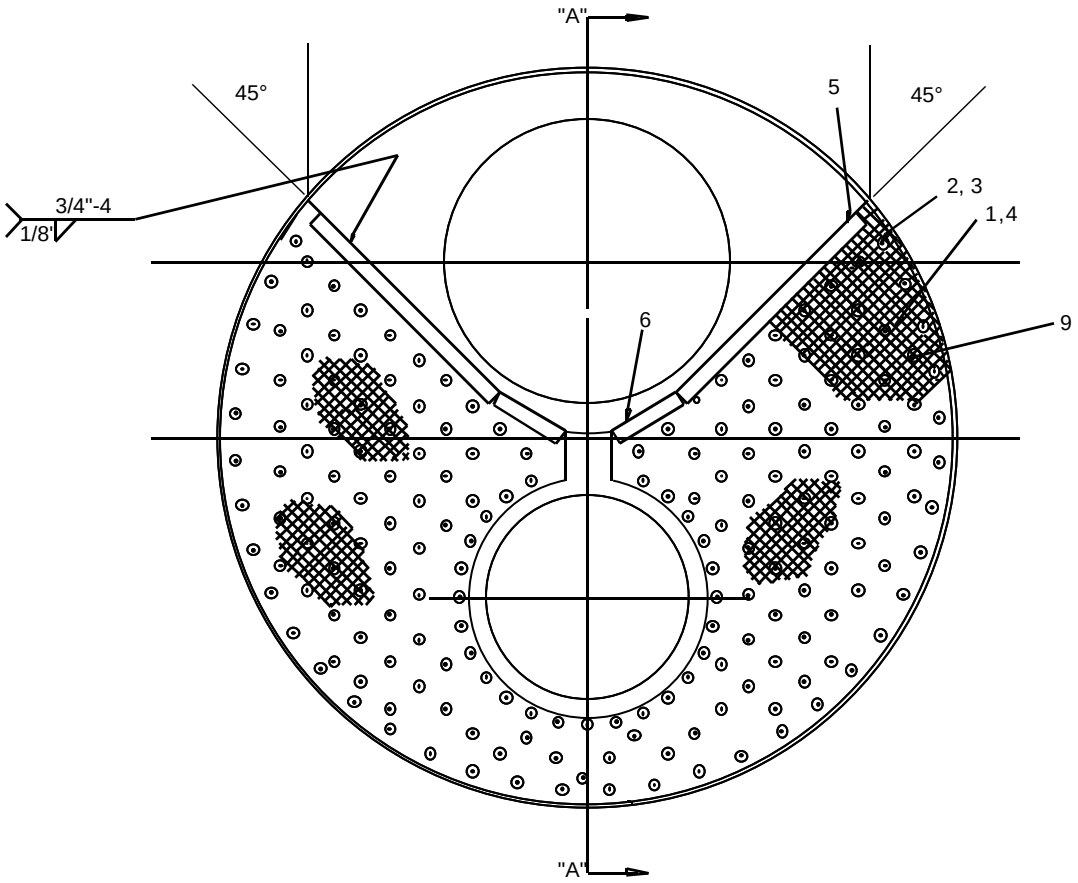
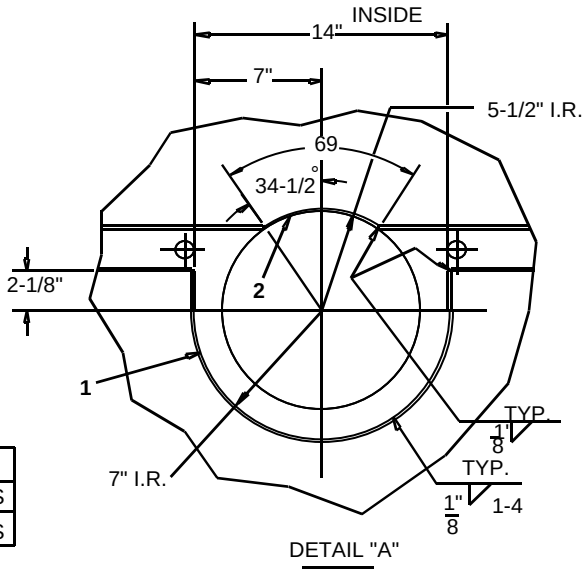


Figure 15: View Inside the Front Head.

4. Modify the inner door for the IFGR control valve fit-up and allow the baffle to go below the control valve opening.
   - Remove the insulation from the inner door as shown on Figure 17, to provide a 14 1/4” opening below the baffle.
   - Cut an 11” diameter hole in the steel portion of the door, as shown in Figures 16 and 17.
   - Remove the flat bar from the inner door baffle location as shown on Figure 17 to make room for the new baffle location. Remove a 6 3/8” section from the upper bar. Remove a 14” section from the lower bar.
   - The flat bar (item 1, Figure 17) should be bent to a 7” inside radius, with a 2 1/8” straight length on each end. Weld the 14” semi circle on the inner door completing the lower portion of the baffle fit-up area.
   - The 6 11/16” bar (item 2, Figure 17) should be bent to a 5 1/2” inside radius. Weld the 6 11/16” bar to the upper portion of the baffle fit-up area.

Figure 16: Cut a Hole in the Inner Door.



ITEM	REQ.	PART NO.	DESCRIPTION
1	1	973-6	SHEET, #10 GA. (.1345) X 2" X 26-7/16" LG. HRS
2	1	973-6	SHEET, #10 GA. (.1345) X 2" X 6-11/16" LG. HRS

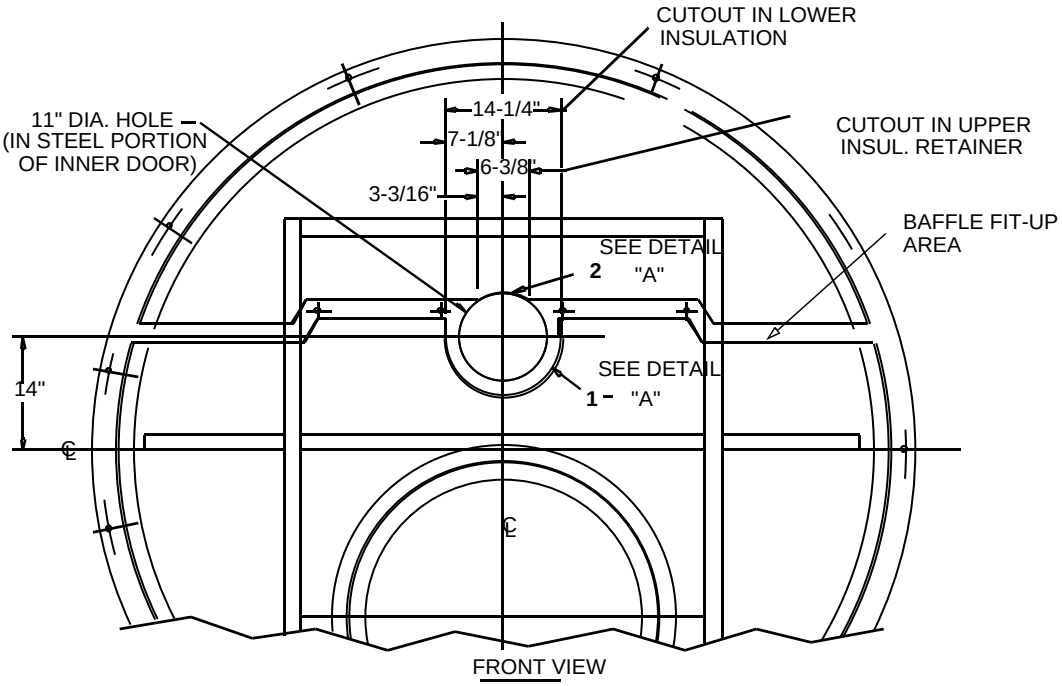


Figure 17: Rework of the Inner Door. (Viewed from vessel side)

5. Modify the front baffle to provide a space for the IFGR control valve to pull gases from the end of the fourth pass.
   - Cut a 7 1/8” by 12 3/4” section out of the baffle, as shown on Figure 18. Also insure that the center bolts are no longer than 1 1/4” by cutting off any additional length.
   - Weld the steel section to the baffle where the cutout has been made. Seal weld the back plate to the semi-circle and either cut the protruding corners or bend in line with the fabricated baffle. Drill holes in the edge of the added section to retain the gasket as shown in Figure 18.
   - Install the gasket on the edge of the baffle, using the rivets supplied.

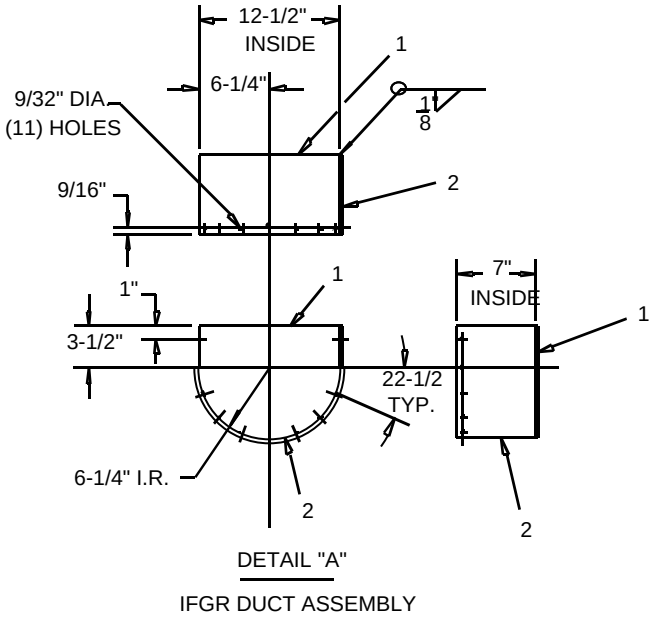


Table 3: Baffle Part Numbers and Description.

ITEM	REQ.	PART NO.	DESCRIPTION
1	1	973-6	SHEET, #10 GA. (.1345) X 9-3/4" X 12-1/2" LG. HRS
2	1	973-6	SHEET, #10 GA. (.1345) X 7" X 26-7/8" LG. HRS
3	1	853-394	GASKET, 9/16" BULB X 2" X 111" LG.
4	1	971-291	STRIP, PERF. #16 GA. X 7/8" X 111" LG.
5	33	841-551	RIVET, SPLIT .225 DIA. X 3/4" LG.

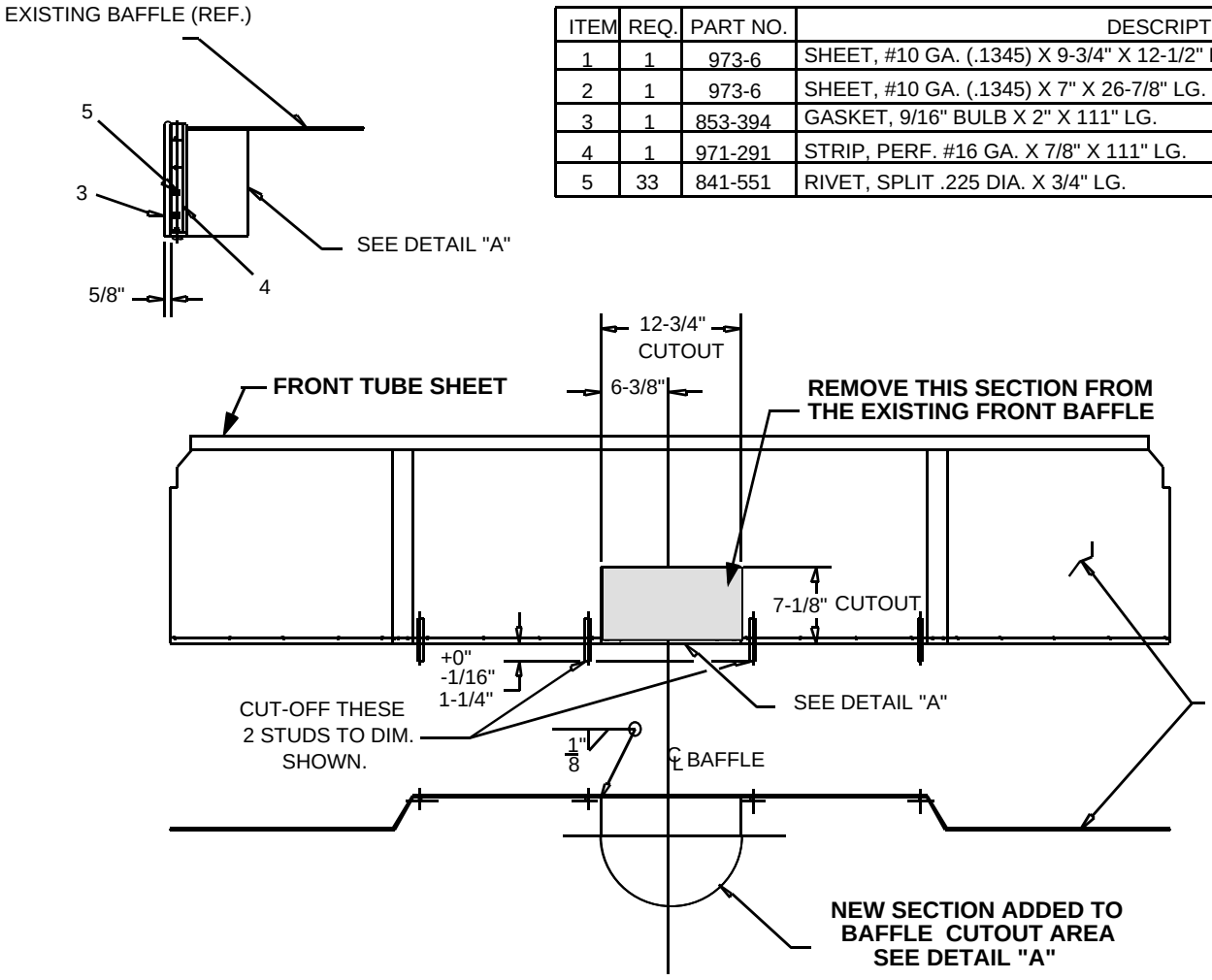


Figure 18: Inner Baffle Layout.

6. Windbox modification for the IFGR control valve and linkage
   - Remove and discard the cover of the back of the windbox.
   - Drill three holes in the bottom of the windbox for the linkage and bearing block mounting, as shown on Figure 20. Install the bearing block, item 2 on Table 4 and figure 25.
   - Install the IFGR control valve and cover plate, as shown on Figures 19 and 23. The valve shaft must pass through the bottom of the windbox (bearing block). The valve shaft should be lubricated with high temperature anti-seize compound at the bearing. It may be helpful to cut a notch in the bottom of the valve shaft to indicate valve location, as shown on Figure 21. Install and adjust the threaded rods to hold the valve in position against the impeller housing (see Figure 23). These rods will help to retain the position of the components when the head is closed.
   - Install the insulation and retainer on the end of the IFGR control valve, as shown on figures 22. These items will seal against the

Figure 19: IFGR Valve in Wind Box.

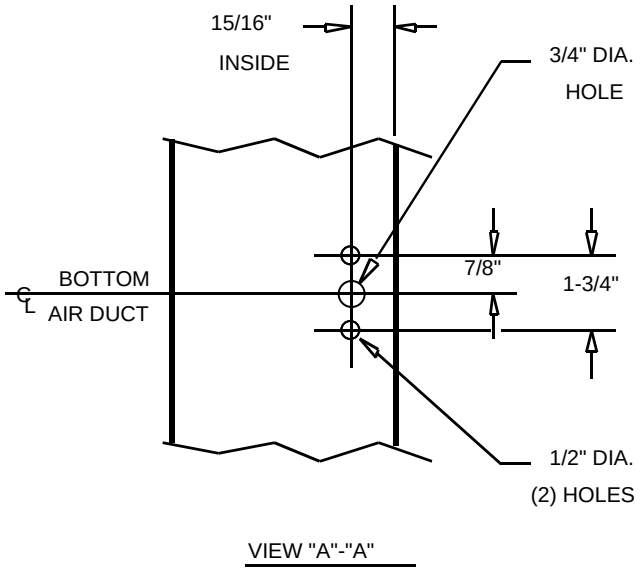


Figure 20: Hole Location in the Bottom of the Wind Box.

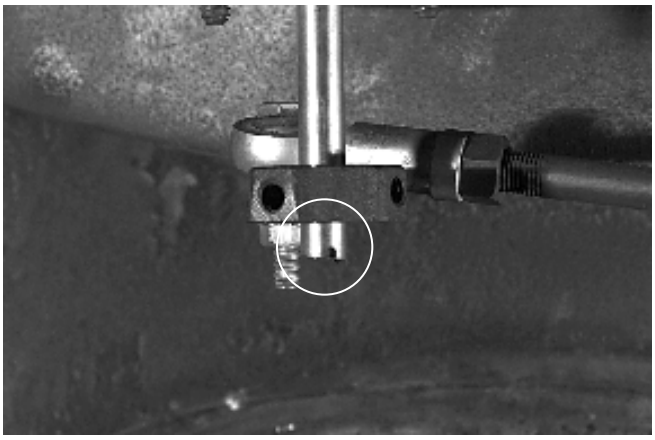


Figure 21: Slot IFGR Actuating Rod Parallel with the Valve Damper.

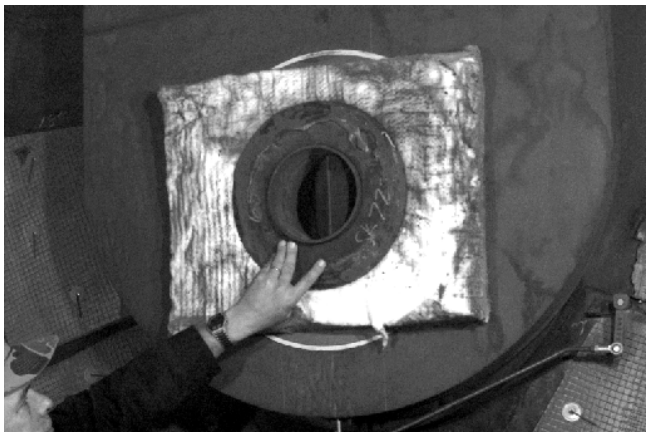
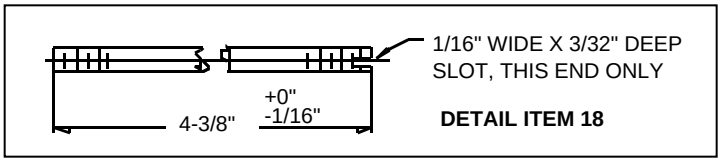


Figure 22: Install Insulation and Retainer.

Table 4: Parts List for IFGR Valve Installation.

ITEM	REQ.	PART NO.	DESCRIPTION
1	1	SEE TABLE	DAMPER ASSEMBLY, IFGR
2	1	306-C-79	BEARING PLATE ASSEMBLY
3	1	19-C-1328	COVER PLATE, AIR DUCT
4	1	872-278	INSULATION, BLANKET 1" X 18" O.D. (SEE NOTE)
5	1	797-2374	ADHESIVE
6	1	32A2556	GASKET, DAMPER IFGR
7	2	868-405	CAPSCREW, HEX. HD. 1/4"-20 X 7/8" LG.
8	2	869-21	NUT, HEX. 1/4"-20
9	2	952-294	WASHER, FLAT 1/4"
10	2	952-92	LOCKWASHER, 1/4"
11	8	869-36	NUT, HEX. 5/16"-18
12	8	952-297	WASHER, FLAT 5/16"
13	8	952-114	LOCKWASHER, 5/16"
14	1	32A2327	GASKET, COVER PLATE
15	1	32A2328	GASKET, SEAL 88-1/2" LG.
16	1	853-899	GASKET, AIR DUCT TO FRONT HD. 97" LG. (NOT SHOWN)
17	1	SEE TABLE	RETAINER, INSULATION
18	4	841-338	THREAD STOCK, 3/8"-16 X 4-3/8" LG. (SEE DETAIL)
19	4	869-30	NUT, HEX. 3/8"-16
20	4	952-93	LOCKWASHER, 3/8"
21	1	32A2555	GASKET, BEARING PLATE



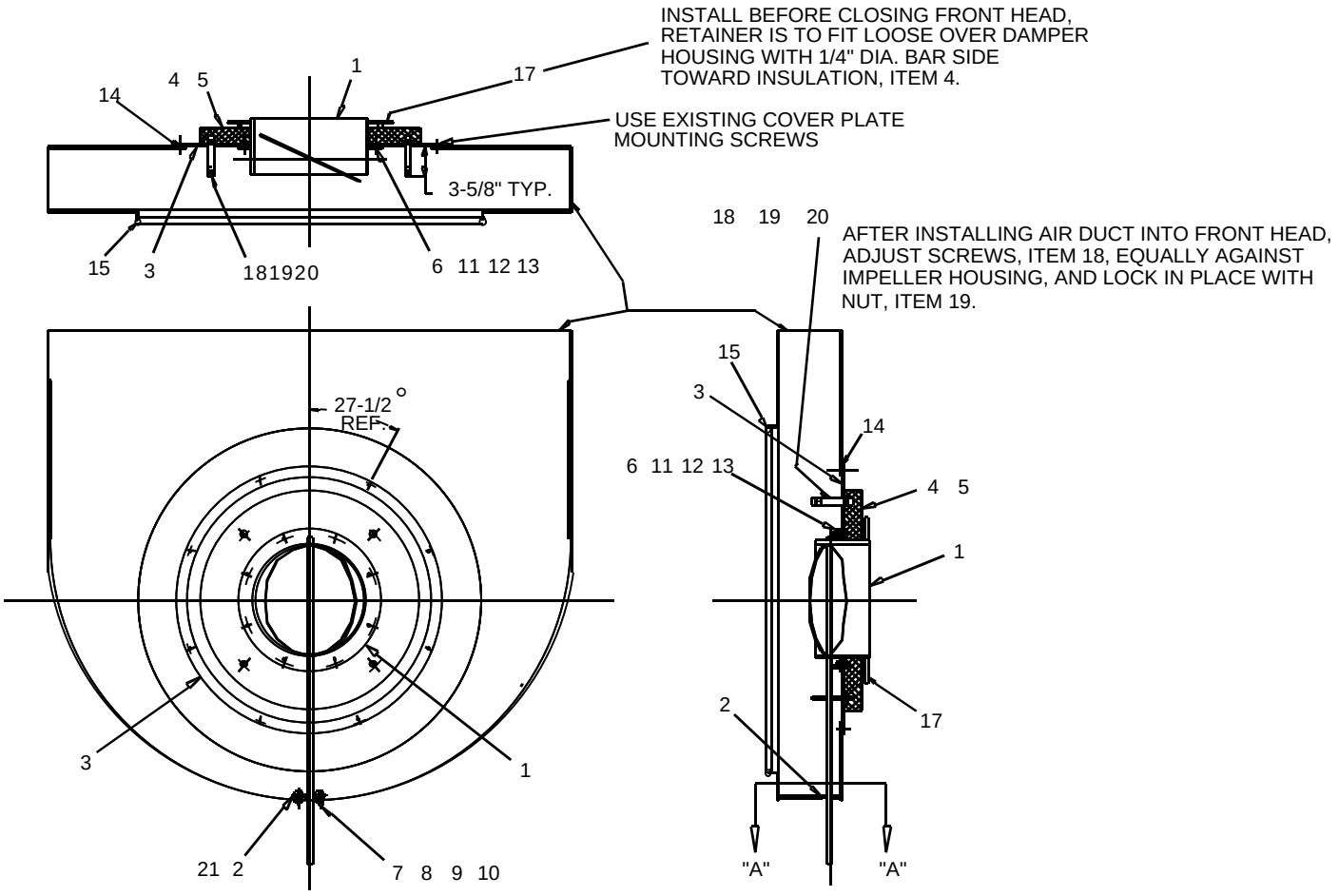

INSTALL BEFORE CLOSING FRONT HEAD, RETAINER IS TO FIT LOOSE OVER DAMPER HOUSING WITH 1/4" DIA. BAR SIDE TOWARD INSULATION, ITEM 4.
USE EXISTING COVER PLATE MOUNTING SCREWS
AFTER INSTALLING AIR DUCT INTO FRONT HEAD, ADJUST SCREWS, ITEM 18, EQUALLY AGAINST IMPELLER HOUSING, AND LOCK IN PLACE WITH NUT, ITEM 19.
3-5/8" TYP.
27-1/2° REF.
"A"
"A"

Figure 23: Rework Required to the Existing Wind Box for the IFGR Valve Installation.

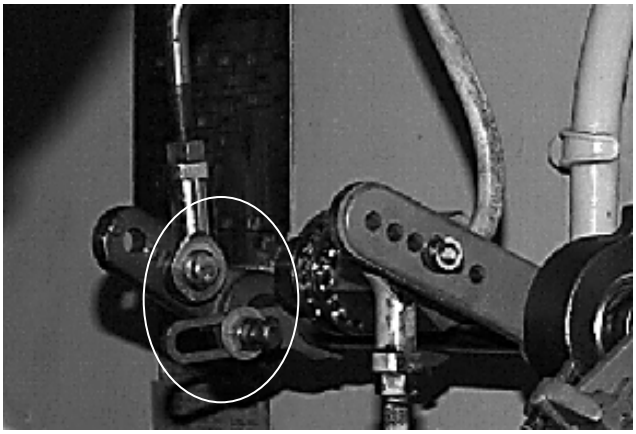


Figure 24: Dual Position Linkage

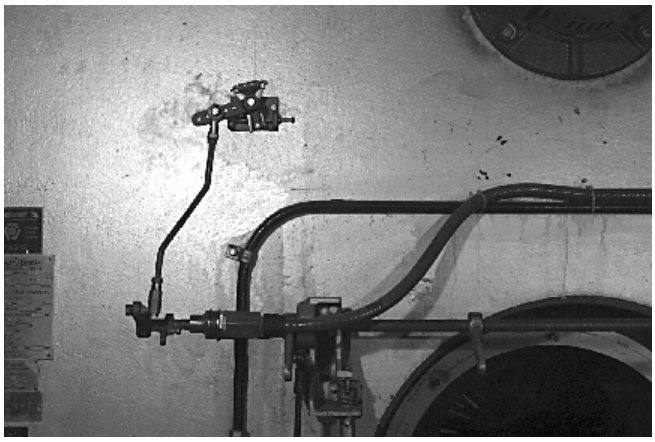


Figure 25: Manual Linkage Change-Over

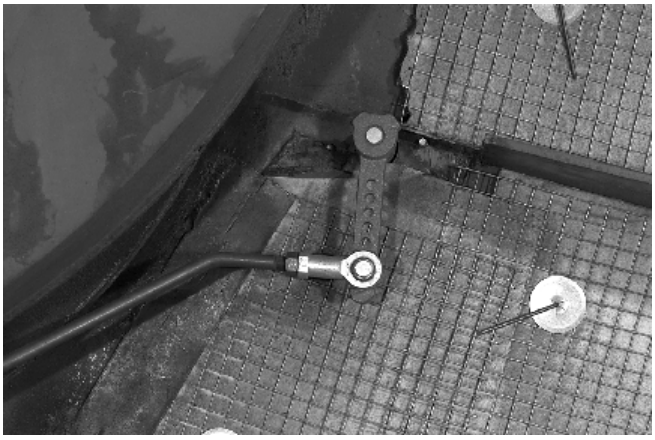


Figure 26: Linkage Inside Front Head

inner door, and insure that no insulation breaks free and plugs the valve or burner opening.

7. There are two linkage styles used for IFGR systems, a single position drive used for single fuels (see Figure 27) and a dual position drive used for dual fuels (see Figure 28).The dual position drive allows for two different FGR flow rates, matching the combustion requirements for each fuel. (see Figure 24). The linkages are the same except for the connections to the jackshaft.
   - Install the over-travel mechanism on the front head (item 1, Figure 27 and 28). Connect the linkage (items 3, 6 and 10) from the over-travel mechanism on the door to the IFGR damper rod, as shown on Figures 25, 26, 27 and Table 6.
   - Install the 3/4” jackshaft assembly on the front head, as shown on Figure 24 and 25.
   - Install the linkage between the shaft assembly and the jackshaft.
   - For a single fuel system, this is a link (item 2) and drive arm (item 7) as shown on figure 27.
   - For dual fuel systems, there are two drive arms (items 5 and 16) on the jackshaft and one link (item 2). A proximity sensor (item 18) is located of the jackshaft. Adjust the position of the components as shown on Figures 34, 36 and Table 6. Install the “GAS OIL” nameplate on the front head as shown on Figure 28.
   - Set the linkage to the initial settings described on Table 8 and Figures 34, 35, and 36.

Note: Check the movement of the IFGR linkage by rotating the jackshaft throughout its normal travel. The linkage and valve should move smoothly without jerky actions and without interference or strained movement.

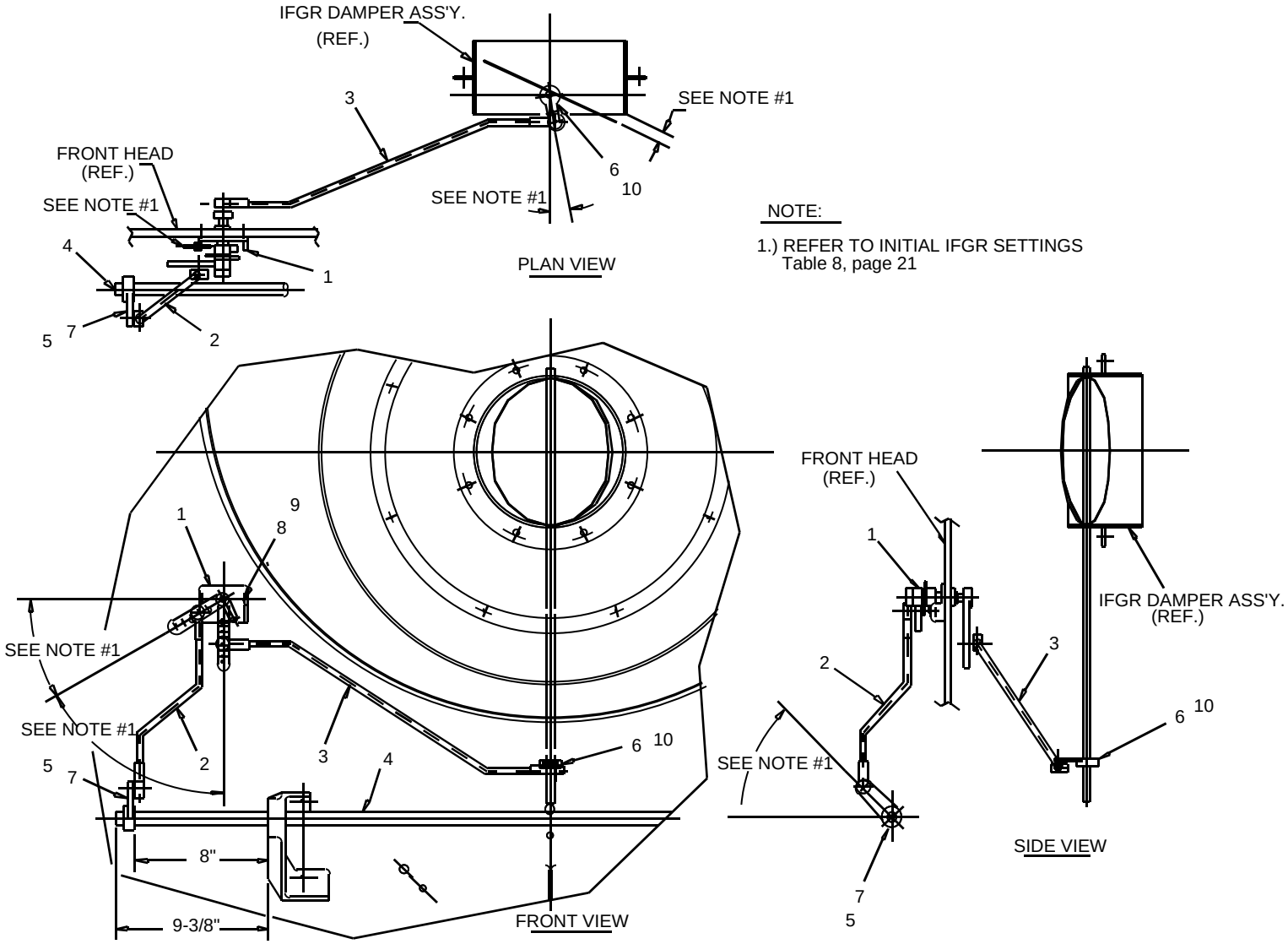


Figure 27: Linkage Assembly for IFGR Retrofit SINGLE FUEL

Table 5: Linkage Assembly Part Numbers and Description SINGLE FUEL

ITEM	REQ.	PART NO.	DESCRIPTION
1	1	427-C-251	DAMPER CONTROL, SHAFT ASSEMBLY
2	1	67-A-796	LINKAGE ASSEMBLY, JACKSHAFT
3	1	476-C-223	LINKAGE ASSEMBLY, DAMPER
4	1	974-42	JACKSHAFT, 3/4" DIA. X 47-1/2" LG. (CHAM. BOTH ENDS)
5	1	2-A-331	DRIVE ARM, JACKSHAFT
6	1	287-A-50	DRIVE ARM, DAMPER
7	2	860-39	SETSCREW, SOCKET HD. 1/4"-20 X 3/8" LG.
8	2	868-136	CAPSCREW, HEX. HD. 1/4"-20 X 3/4" LG.
9	2	952-92	LOCKWASHER, 1/4"
10	2	860-101	SETSCREW, SOCKET HD. 1/4"-20 X 1/2" LG.

NOTES:

1. REFER TO TABLE 8, PAGE 21 FOR INITIAL IFGR SETTINGS.
2. ATTACH CONDUIT ADAPTER, ITEM 19, TO PROXIMITY SWITCH, ITEM 18, AND RUN PROXIMITY SWITCH WIRES THROUGH NON-METALLIC CONDUIT, ITEM 30.

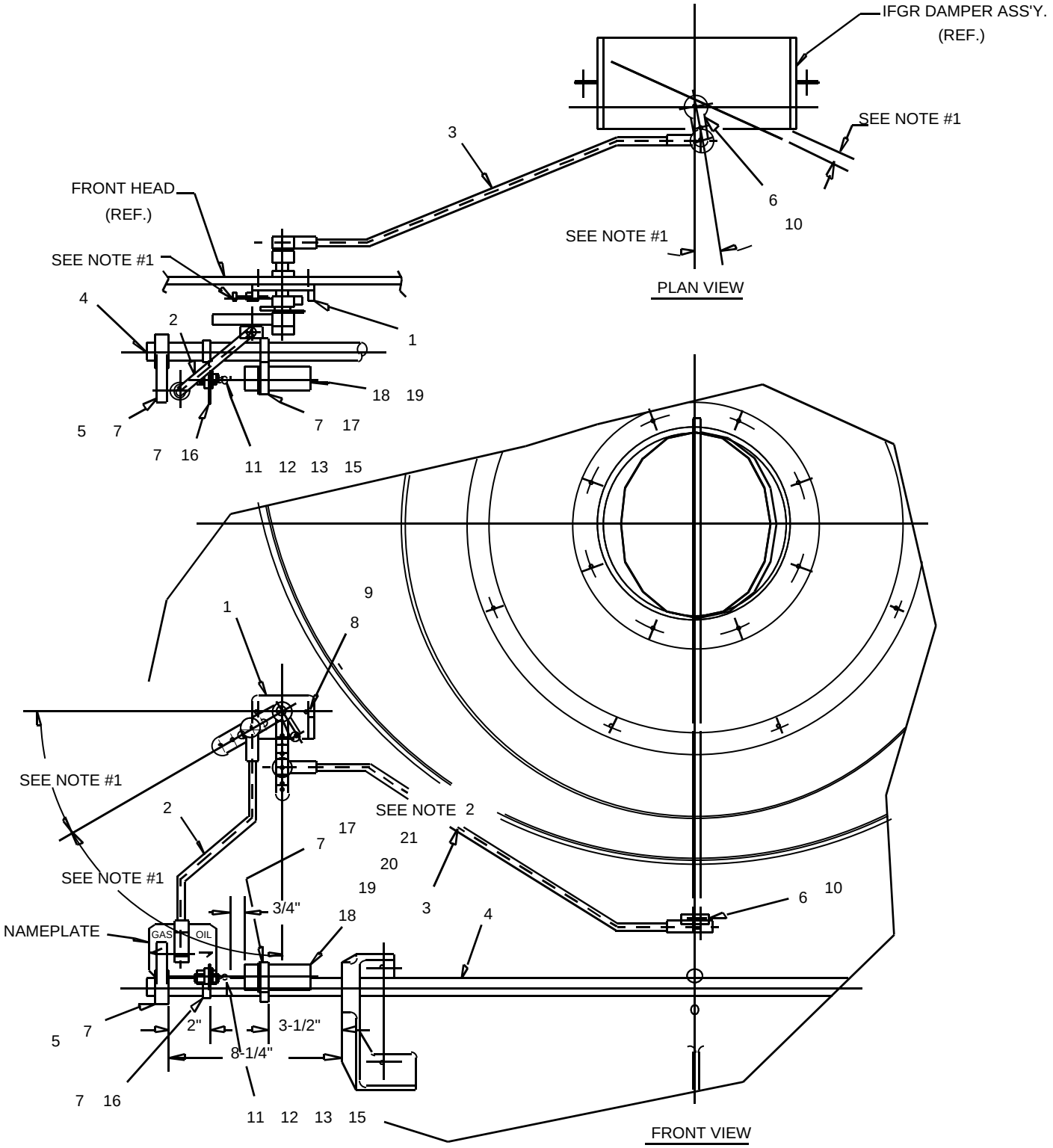


Figure 28: Linkage Assembly for IFGR Retrofit DUAL FUEL (1 of 2)

Table 6: Linkage Assembly Part Numbers and Description DUAL FUEL

ITEM	REQ.	PART NO.	DESCRIPTION
1	1	427-C-251	DAMPER CONTROL, SHAFT ASSEMBLY
2	1	67-A-798	LINKAGE ASSEMBLY, JACKSHAFT
3	1	476-C-223	LINKAGE ASSEMBLY, DAMPER
4	1	974-42	JACKSHAFT, 3/4" DIA. X 47-1/2"" LG. (CHAM. BOTH ENDS)
5	2	2-A-332	DRIVE ARM, JACKSHAFT
6	1	287-A-50	DRIVE ARM, DAMPER
7	4	860-39	SETSCREW, SOCKET HD. 1/4"-20 X 3/8" LG.
8	2	868-136	CAPSCREW, HEX. HD. 1/4"-20 X 3/4" LG.
9	2	952-92	LOCKWASHER, 1/4"
10	2	860-101	SETSCREW, SOCKET HD. 1/4"-20 X 1/2" LG.
11	1	883-70	BALL SCREW, FOR TUTHILL NO. S-109 QUICK DISCONNECT
12	1	869-22	NUT, HEX. 3/8"-24 UNF
13	1	952-93	LOCKWASHER. 3/8"
14		NOT USED	NOT USED
15	2	952-106	WASHER, FLAT 3/8" SAE TYPE
16	1	2-A-333	DRIVE ARM, JACKSHAFT (OIL)
17	1	2-A-334	ARM, JACKSHAFT PROXIMITY SWITCH MOUNTING
18	1	836-1032	PROXIMITY SWITCH
19	1	848-1158	CONDUIT ADAPTER, 1/2" NPT X 30 MM
20	2	848-1159	CONDUIT FITTING, 1/2" NPT STRAIGHT, NON-METALLIC
21	1	848-1160	CONDUIT,1/2" FLEXIBLE, NON-METALLIC (CUT TO SUIT)

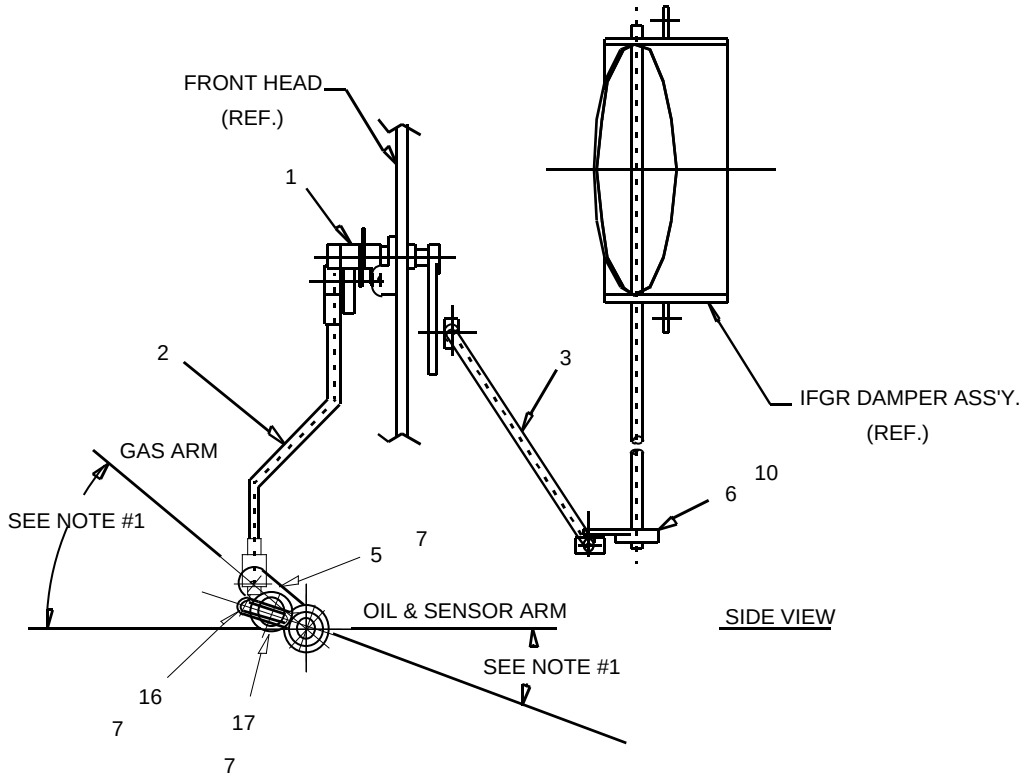


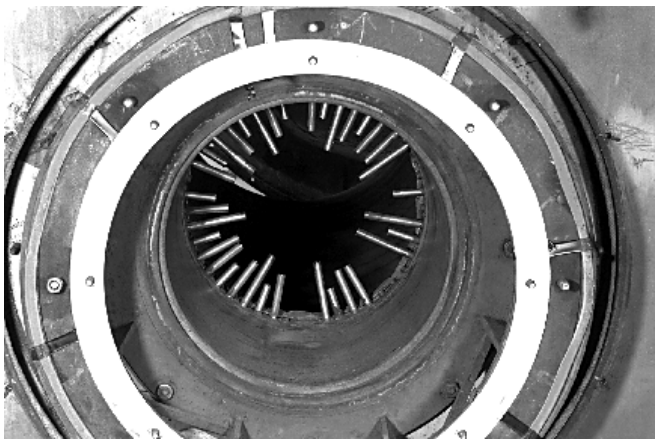
Figure 28: Linkage Assembly for IFGR Retrofit DUAL FUEL (2 of 2)

Table 7: Gas Spud Description and Part Numbers

	400 HP. ASS'Y 090 1627		500 HP. ASS'Y 090 1623		600 HP. ASS'Y 090 1624		700 & 800 HP. ASS'Y 090 1626		BASIC BILL OF MATERIAL
ITEM	REQ.	PART NO.	REQ.	PART NO.	REQ.	PART NO.	REQ	PART NO.	DESCRIPTION
1	1	887-27	1	887-27	1	887-27	1	887-27	ANTI SEIZE COMPOUND
2	6	57-1025	9	57-1025	11	57-1025	5	57-1025	GAS SPUD, 1/4 NPS 4-1/4 LG.
3	13	57-1024	12	57-1024	4	57-1024	8	57-1024	GAS SPUD, 1/4 NPS 2-1/4 LG.
4	16	57A1023	0	57A1023	24	57A1023	20	57A1023	GAS SPUD, 1/4 NPS 1-1/4 LG.
5	8	858-1084	9	858-1084	5	858-1084	8	858-1084	PLUG, PIPE 1/4 NPT BRASS
6	0	57-1197	14	57-1197	0	57-1197	3	57-1197	GAS SPUD, 1/4 NPS X 3-1/4" LG.

NOTE: APPLY NEVER SEEZ COMPOUND, ITEM 1 , TO SPUDS AND PLUGS BEFORE INSTALLING.

NOTE! SPUD PATTERN SHOWN IS AS VIEWED FROM FRONT OF BOILER THROUGH THE HOUSING.



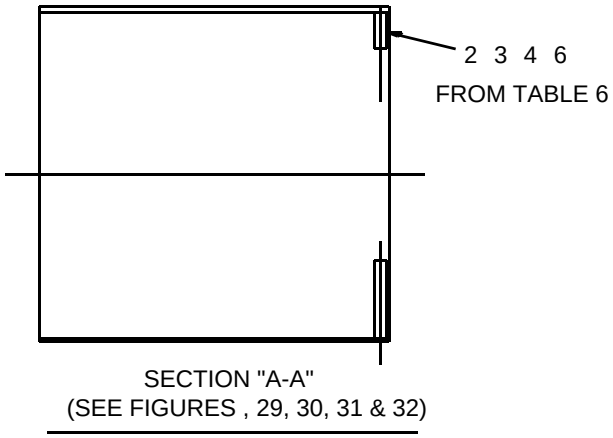


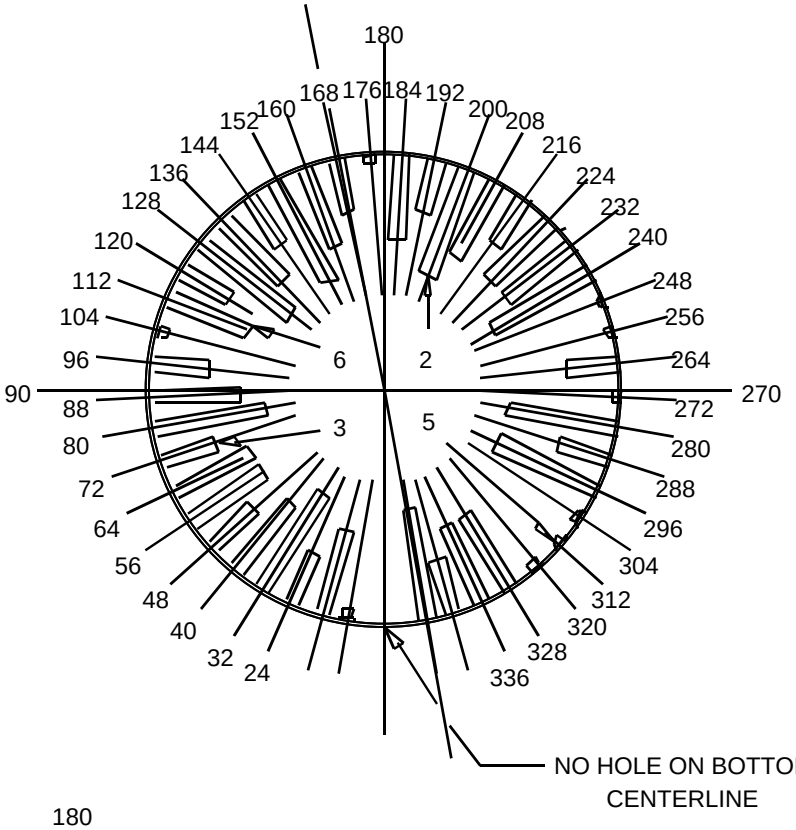
Figure 29: Spuds, Burner Housing and Gaskets in Place.

8. The burner requires certain components and configurations to function as a low NOx burner. For a gas burner, the diffuser and gas spud arrangement is required. The diffuser is provided with the IFGR kit. The gas spuds are also included in the kit, and are to be installed as shown on Table 7 and Figures 29-33. Anti-seize compound is required on the gas spuds to prevent the threads from seizing. A combination gas/oil burner will require a High Turn-down style oil gun in addition to the above items. If the boiler uses a straight oil burner, the diffuser and oil gun must be installed to allow the burner to function properly.
9. The motor size change will require changes to the motor starter and fuses, which are included in the kit. In addition, the wiring and supply capacity should be reviewed to insure that they meet the requirements for the new motor, National Electric Code and any other codes may apply to the installation.

⚠ CAUTION

The conduit connection to the proximity sensor must be positioned to allow free movement of the sensors during modulation. If the unit is equipped with a proximity sensor, insure that the cables are allowed free movement. Failure to follow this caution could result in equipment damage.

Figure 30: Spud Pattern CB 500 h.p. (#090 1623).



Note:
Spud patterns shown as viewed from the front of the boiler

Figure 31: Spud Pattern CB 600 h.p. (# 090 1624).

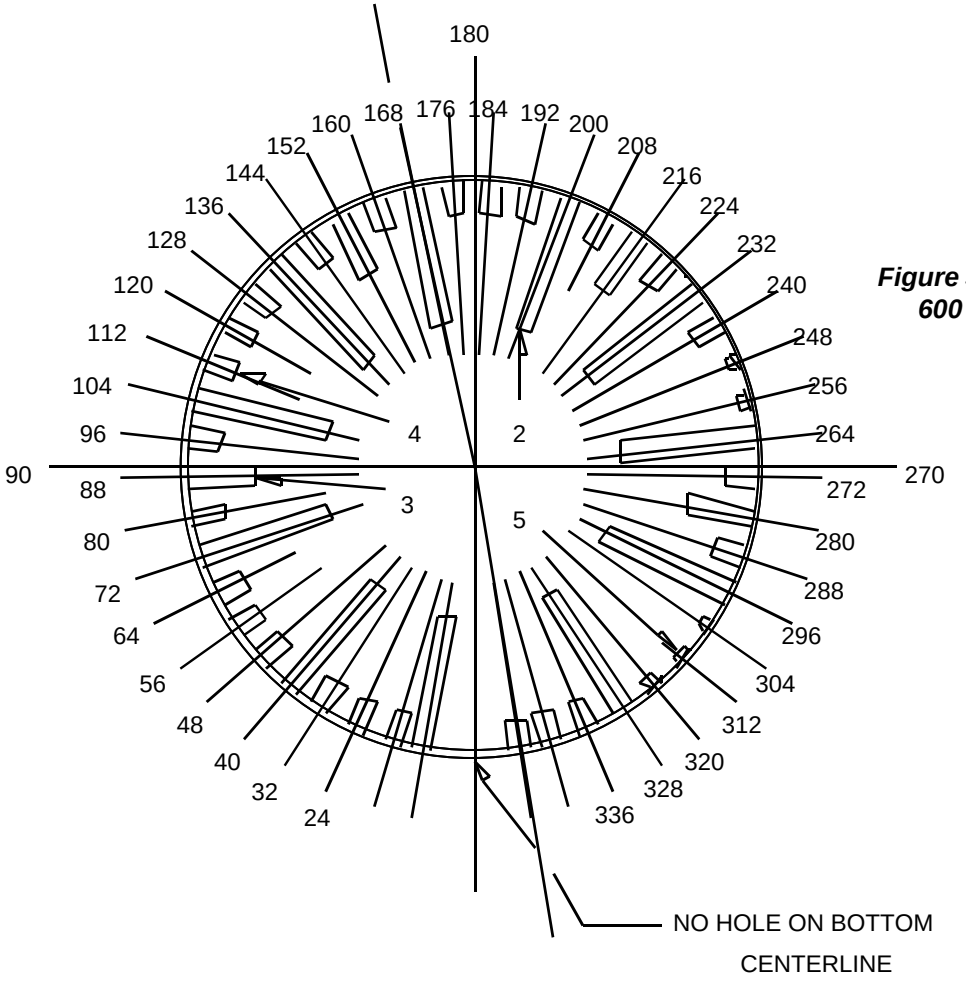
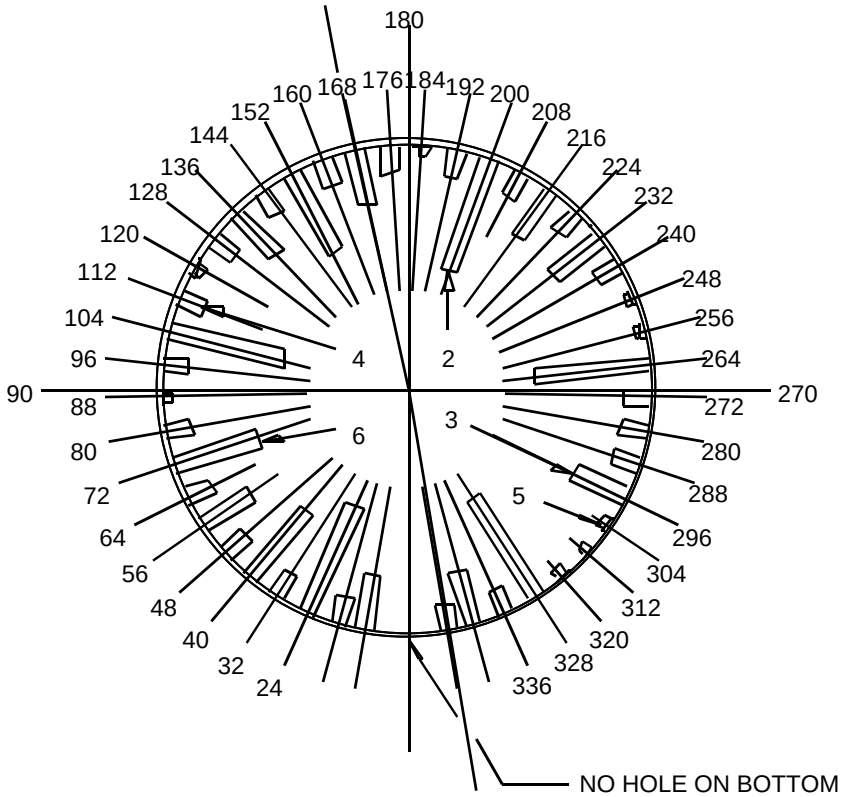


Figure 32: Spud Pattern CB 700 & 800 h.p. (# 090 1626).



Note:
Spud patterns shown as viewed from the front of the boiler

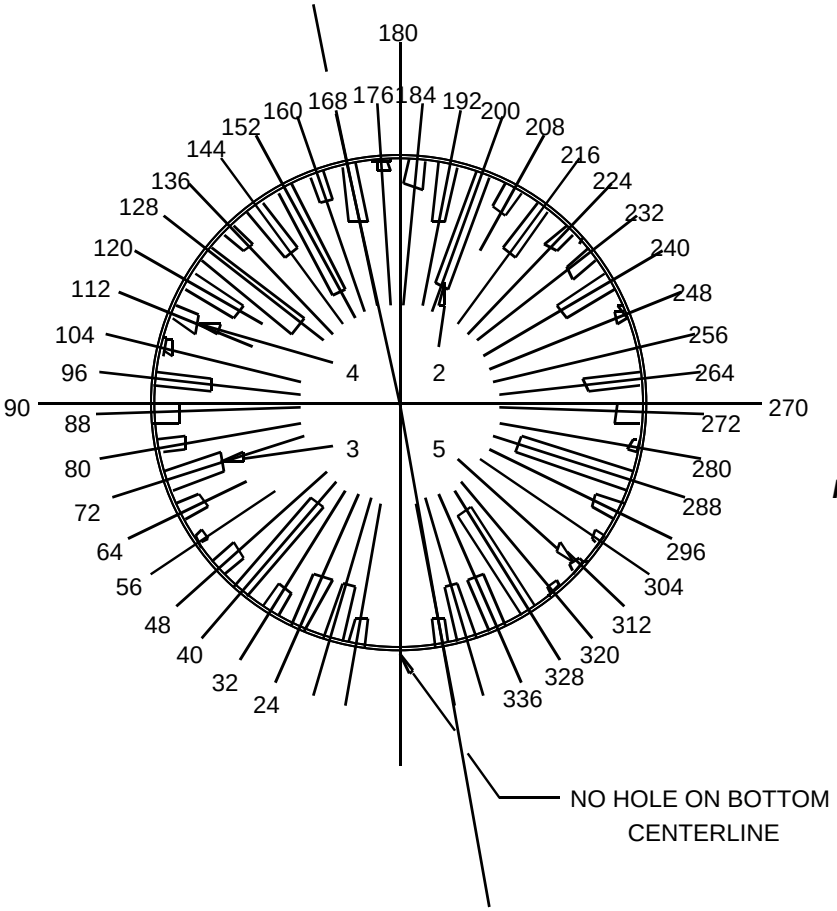


Figure 33: Spud Pattern CB 400 h.p. (# 090 1627).

NOTE: HOLE @ 256 TO BE LEFT OPEN.
(NO PLUGS OR SPUDS)

Table 8: Initial Settings for Setup of the IFGR System of Standard CB Boilers 400-800 hp.

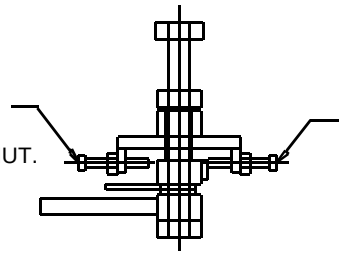
BOILER HP	PPM NOX	“A”	“B”	“C”	“D”	“E”	“F”	“G”	“H”	“I”	“J”
400	30	15°	1"	2-3/4"	#1	#4	20°	70°	#8	40°	20°
500	30	15°	1"	2-3/4"	#1	#4	20°	70°	#8	40°	20°
600	30	15°	1"	2-3/4"	#1	#4	20°	70°	#8	40°	20°
700	30	15°	1"	2-3/4"	#1	#4	20°	70°	#8	40°	20°
800	30	15°	1"	2-3/4"	#1	#4	20°	70°	#8	40°	20°

NOTE !

SETTINGS SHOWN ARE APPROXIMATE INITIAL SETTINGS ONLY,
ACTUAL FIELD SETTINGS WILL VARY FROM BOILER TO BOILER.

IMPORTANT !

AFTER CONNECTING THE DAMPER LINKAGE, BUT BEFORE CONNECTING THE JACKSHAFT LINKAGE, MANUALLY ROTATE THE DAMPER CONTROL SHAFT UNTIL THE DAMPER IS IN THE FULL OPEN POSITION. THEN ADJUST THE SCREW TO TOUCH THE STOP ARM AND LOCK IN PLACE WITH THE LOCK NUT.



AFTER SETTING THE CONTROL SHAFT DRIVE ARMS AS SHOWN IN THE FRONT VIEW, ADJUST THE SCREW TO TOUCH THE STOP ARM AND LOCK IN PLACE WITH THE LOCK NUT.

PLAN VIEW

Figure 34: Damper Control Stop Screw Setting.

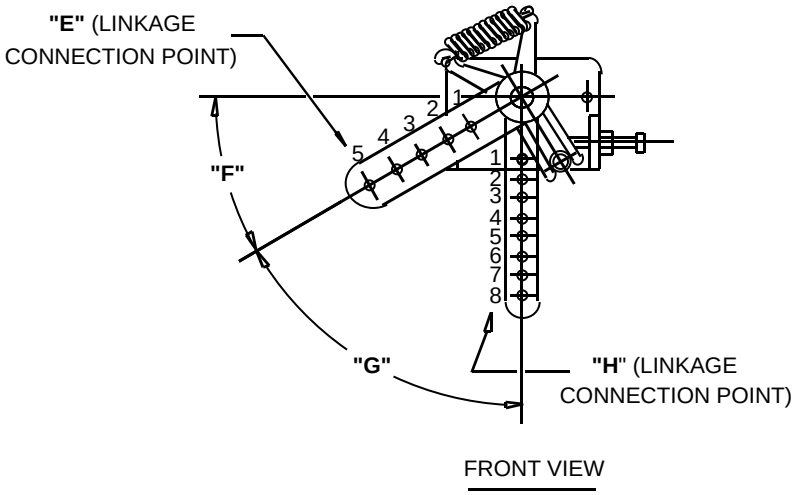


Figure 35: Damper Control Shaft Settings.

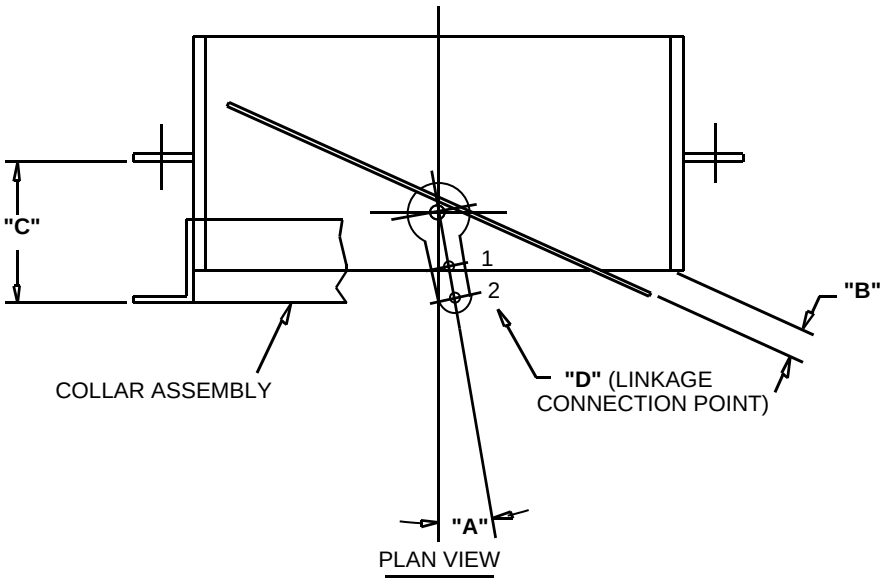


Figure 36: Damper Settings.

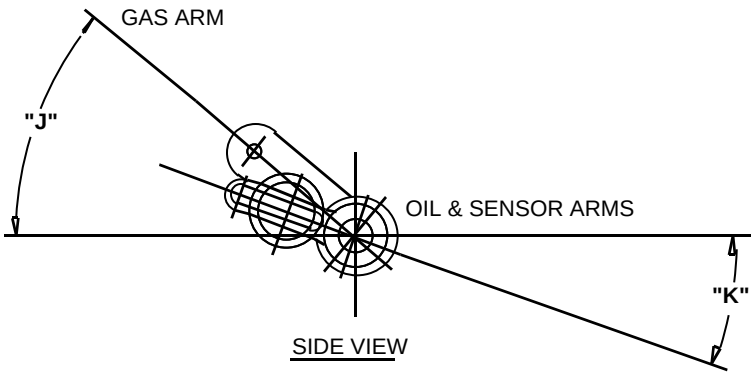


Figure 37: Jackshaft Arm Settings.

BURNER SETUP

The burner setup and adjustments are defined in the CB-LE Firetube Operation and Maintenance manual (750-94). Burner setup and adjustments should only be performed by a combustion technician trained in low emission Firetube burner setup and adjustment

- NOx levels on natural gas will be less than 30 ppm (corrected to 3% Oxygen, dry basis) throughout the operating range. There are no NOx emission guarantees for oil firing.
- CO levels on gas firing will be less than 200 ppm (air free basis) throughout the operating range.
- Smoke spots levels on oil firing will be less than a #2 (Bacharach or ASTM).
- Turndown will be 4-to-1 on the standard burner (both gas and oil). The optional high turndown burner will provide 8-to-1 turndown on gas and 6-to-1 turndown on oil.

⚠WARNING

Improper adjustment of air, fuel, or flue gas recirculation controls can produce dangerously low excess air levels in the boiler furnace, which under extreme conditions may result in unstable combustion. All adjustments must be made by a qualified Cleaver-Brooks combustion technician. Failure to follow this warning could cause serious personal injury or death.

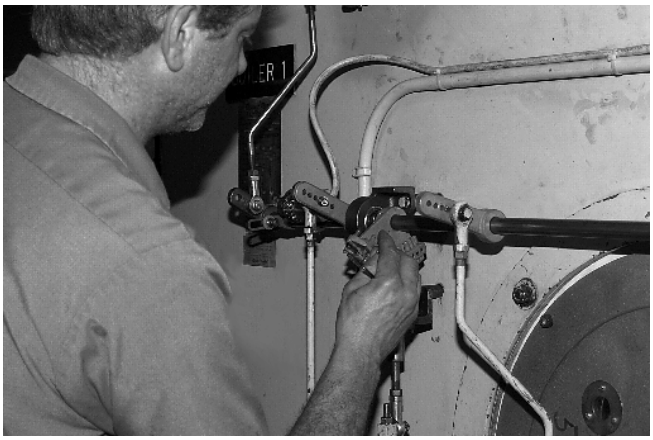


Figure 38: Adjusting Linkage and Setting Combustion.

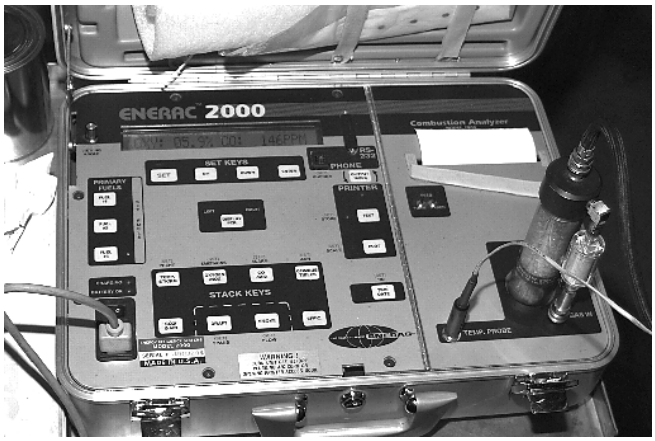


Figure 39: Combustion Tester.

Notes

NOTES

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Web Address: http://www.cleaver-brooks.com